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ARTHRITIS

A Study of the Inflammatory Diseases of Joints.

The MEDICO-CHIRURGICAL SERIES No. 3

ARTHRITIS

A STUDY
OF THE INFLAMMATORY DISEASES OF JOINTS

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PREFACE.

To Dr. Ironside Bruce, for unfailing trouble, help and tuition in the elucidation of diseases of joints from the X-ray standpoint, both with regard to my own cases and by affording me the benefit of his great experience in this intricate and confused subject, I feel unable adequately to express my grateful thanks, as without his aid I could not have arrived at such firm conclusions as I now hold with regard to the pathology and symptomatology of joint lesions. The loan of the X-ray plates reproduced is the least of his many services.

To Dr. Gauvain, Superintendent of Lord Mayor Treloar's Cripples' Home and College at Alton, I return my best thanks for permission to reproduce three figures illustrating his methods of treating spinal caries, which I greatly admire.

Messrs. G. Ernst, Adlard and Son, and Mayer and Meltzer, I thank for the loan of clichés, and the latter for various other services.

However unorthodox the views herein expressed may appear, I am aware of ever-increasing evidence which supports and strengthens them, and I believe time will serve to prove the main contentions are right.

PETER DANIEL.

Upper Wimpole Street,
London, W.

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ARTHRITIS:

A Study of the Inflammatory Diseases of Joints.

INFLAMMATORY DISEASES OF JOINTS.

In writing this account of inflammations of joints, which is intended as a practical help to their diagnosis and treatment, and in no way a book of reference, I have given my *personal* views and experience wherever possible, and have endeavoured to avoid that great error of quoting "authority" as an unanswerable argument where a departure from the orthodox takes place.

Such great changes have occurred in the pathology of certain joint diseases, that probably half the substance contained in various books on this subject might be deleted, because based upon erroneous data; some depending solely for support upon tradition, others confusing and intermixing former views and explanations in an endeavour to bring them into line with modern pathology and methods of investigation.

This then is an endeavour to put clearly before the reader the *result* of my experience in hospital and private patients, and to clear the ground to some extent in the present transitional period.

I, however, endeavour to give an outline of well-recognized plans in treatment, which appear to be sound, as vast differences exist in theory and practice, but rely chiefly upon the methods elaborated by Bier and others, as well as the ambulatory mode of treatment, which has recently been applied to fractures by Championierre, and which is eminently successful in both types of disease.

As it is impossible to understand intelligently the *evidence* of disease in joints, which is the basis of diagnosis, nor likewise the *rationale* of certain plans of treatment, the why and wherefore, without a certain amount of knowledge of the pathology of such disease, and the anatomical structure of joints, it is first necessary to outline as broadly as possible what these diseases are, and what pathology and anatomical factors are common to all joints.

Joints are subject to the following lesions :—

(1) Congenital displacements or malpositions, aplasia, &c.

(2) Injuries.

(3) New growths.

(4) Inflammations.

(5) Peculiar types of inflammations or degenerations associated with nervous lesions, Arthropathies or Neuropathies.

I confine myself to the various inflammations and arthropathies, and a type of injury designated internal derangement (because this is a purely intra-articular lesion which leads to symptoms of recurring arthritis).

The **structure of joints** in so far as they concern us :—

All joints consist of two bony surfaces, each covered with hyaline (articular) cartilage.

The bony extremities are almost entirely cancellous in structure—*i.e.*, the amount of compact, dense bone on the outside is limited to a minimum.

In health the articular cartilage is firmly united to the bone, being, in fact, the unossified remains of the epiphysial cartilage; it is *non-vascular* and derives its nutrition from the lymph circulating in it, which is derived chiefly from the blood-vessels in the bone—*i.e.*, *it depends upon the subjacent bone for its nutrition*, but the synovium partly contributes to its nutrition.

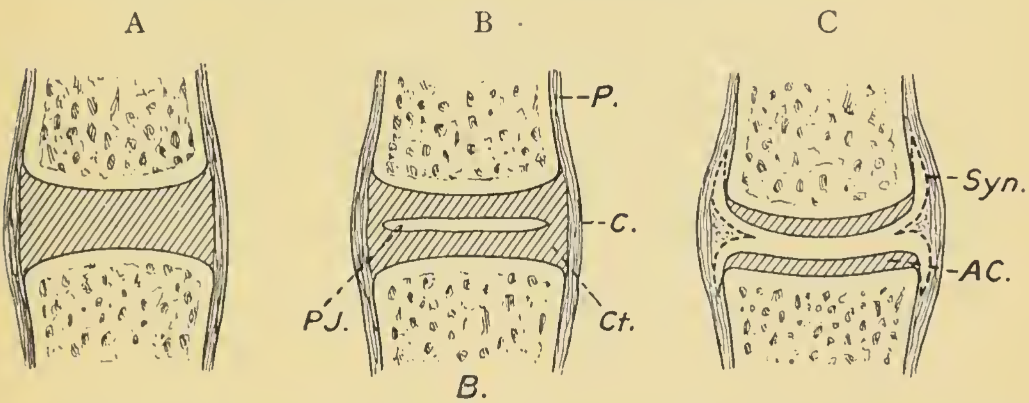

FIG. 1.—Evolution of a joint; diagrammatic. (A) The primitive cartilage remains at the situation of the joint; elsewhere it has become bony. The capsule and periosteum form one continuous membrane. (B) A cleft, *PJ.*, appears in the cartilaginous bar. (C) The joint extremities are being fashioned; the synovial membrane (dotted) is differentiated, and the epiphysial cartilage remains.

Any conditions which influence the bony extremities of necessity produce effects upon the articular cartilage. The influences are manifest chiefly in three directions:—

(1) *Overgrowth.*

(2) *Atrophy and retrogression.*

(3) *Destruction.*

(1) OVERGROWTH.—When the bone or joint is hyperæmic for a prolonged period, overgrowth follows;

this takes place generally where the cartilage, bone, synovial membrane, capsule, and periosteum meet, *i.e.*, where collateral circulation is likely to exist in the periphery of the joint.

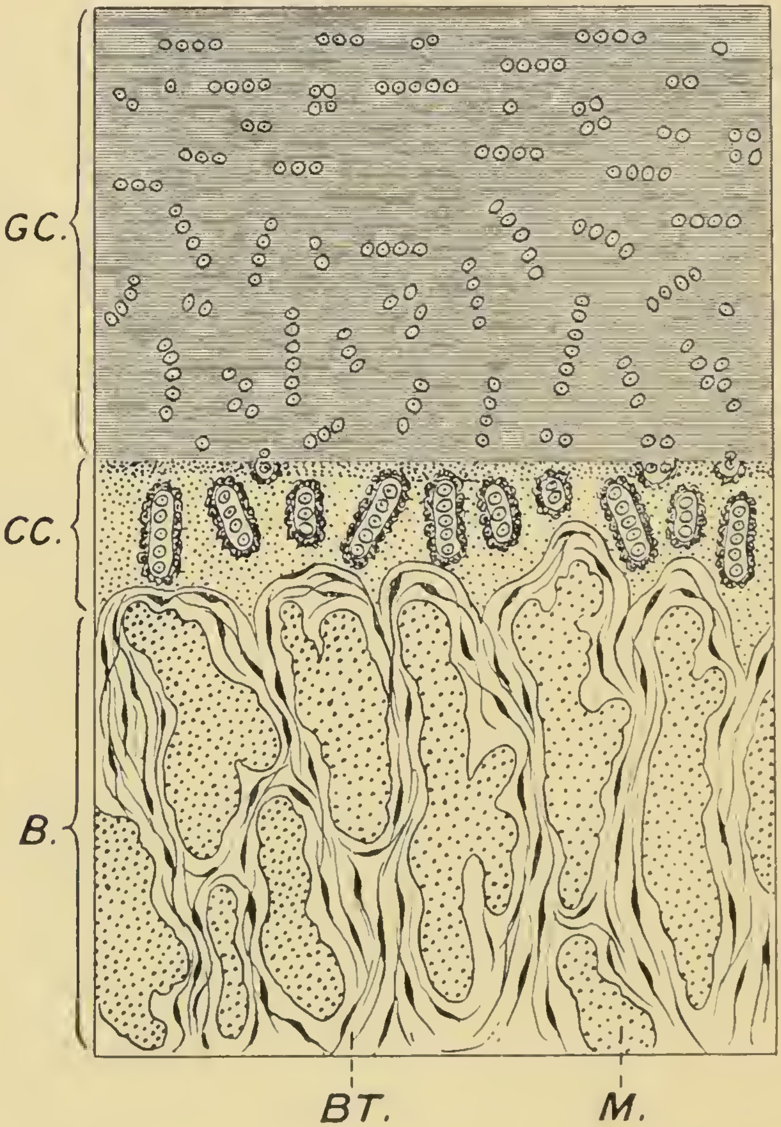

FIG. 2.—After Schäfer. Microscopically shows the development of bone from the primitive cartilage, the *permanent* remains of which forms the articular cartilage. *GC.*, growing cartilage, the upper aspect *is* the articular surface; *CC.*, calcifying cartilage; *B.*, bone; *BT.*, bony trabeculæ; *M.*, marrow.

(2) ATROPHY AND RETROGRESSION (degeneration) as a result of deficient blood supply in chronic and subacute changes in the bone, or toxic processes acting through the blood and lymph-stream or the synovium.

(3) DEATH.—(*a*) By complete loss of blood-supply (necrosis, slough).
(*b*) By intense toxic infection of the lymph (coagulation necrosis).
(*c*) Molecular destruction by the invasion of granulation-tissue.

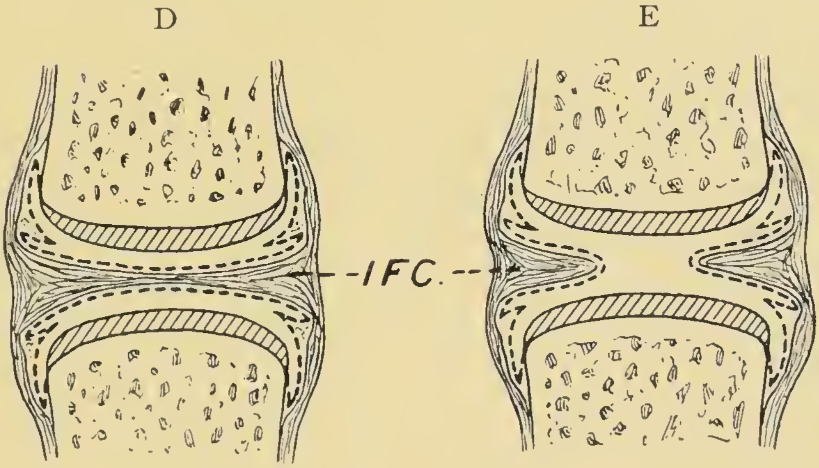

FIG. 3.—Continuation of fig. 1. *D.* shows two, instead of one joint cleft, the intervening lamina becomes the inter-articular fibro-cartilage (*IFC.*), which in *D.* forms a complete meniscus (see fig. 4), but in *E.* only its periphery remains, so forming an incomplete disc. The dotted line shows the relationship of the synovial membrane to each form of disc.

Inter-articular Fibro-cartilages. — In certain joints lamellæ of cartilage of a different structure (fibro-cartilage) are interposed between the cartilage-covered bones; these are washers, forming more or less complete septa or discs, which in some joints completely separate the joint cavity into two spaces; in others they are imperfect and form only partial septa, being incomplete rings or half-circles. They are not of uniform thickness; the most important of them, those in the knee-joints, are wedge shaped on section. They serve various purposes, some as internal ligaments, others fill in inequalities of the bony surfaces when they are of different contours, and others permit of more complex movements in the joints. They are attached by their external margins to the edge of the bones, or to the capsule, or both. (*Vide* Special Joints.)

In general they may be *looked upon* as pleats or folds of the capsule projecting into the joint cavity; consequently the synovial membrane lining the joint must cover them on both aspects. They therefore are supplied with nutrition, derived partly from the sub-synovial blood-vessels, and partly from the bone and capsule.

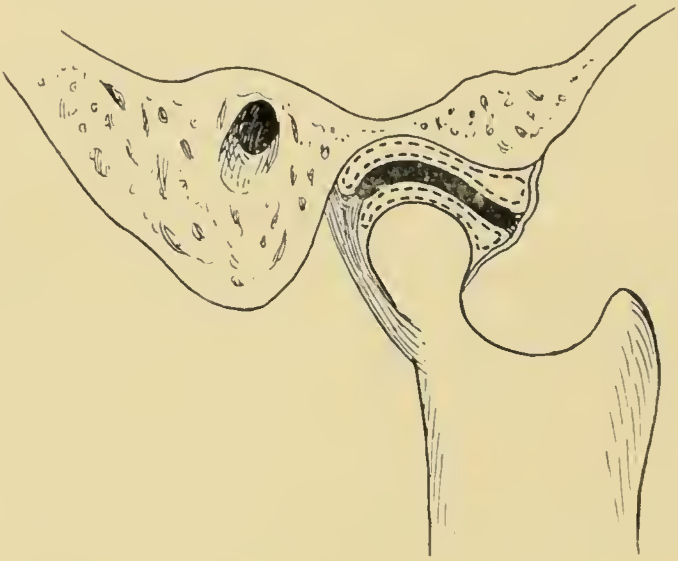

FIG. 4.—The tempero-maxillary joint, showing the meniscus separating the two articular cavities. At its periphery the disc is attached to the capsule.

When they form incomplete rings their extremities are bound down to the bone by fibrous bands or join on to inter-articular ligaments.

Should untoward or violent movements of the bones tear these fibrous attachments, the ends of the cartilages become displaced and a series of symptoms arise which is discussed under "Internal Derangements."

This form of accident or some modification may occur in any joint containing a meniscus.

The Capsule and External Ligaments.—Binding the two bones together and forming a more or less complete sheath is a dense fibrous membrane—the capsule; here and there thickened, according to the character of the movements of the joints, into denser bands *or ligaments*, these may be broad and band-like or rounded and cord-like. Some ligaments are not thickenings in the capsules but are supplementary to the latter, usually lying *outside* the capsule, but in certain cases passing *inside* the joint cavity; these usually represent suppressed tendons or muscle attachments.

The capsules are usually incomplete; the gaps in some instances merely transmit vessels and nerves, in certain cases tendons, or serve as communications with bursæ, while in others large gaps exist where the joint cavity is enclosed only by the synovial membrane, or at times by muscle origins and tendons; thus there are *weak spots* where intra-articular tension is least resisted, and by which inflammation, &c., may more easily invade the synovial membrane. In such weak spots the bones generally find exit from the joint in "regular" dislocations.

The attachment of the capsule to the bone varies with the type of joint, and while in some cases such attachment takes place just beyond the junction of articular cartilage and bone, in others it is at a considerable distance, in which instances a large amount of bone, other than the cartilage-covered surface, may lie *inside* the capsule, such for instance as the neck of the femur.

I wish to lay emphasis on this point, as it is my belief *many cases of effusion into joints are merely types of œdema,* due to disease of the bones inside the capsule.

The capsules are of more importance in binding some bony extremities than others; in such cases they are essential to the strength and stability of the joint, in others they are lax and the stability and strength of the joint depends upon other factors, especially the tonicity of the muscles; consequently certain differences occur in the intensity of symptoms and in the after-effects of arthritis in so far as these depend upon the character of the capsules.

Joints firmly supported by ligaments are more prone to sprains, while those dependent upon muscular tonicity are more liable to dislocation.

Tears or lacerations, thickenings and matting of the capsule and ligaments play a large part in the results attained after injuries and diseases, and especially the sequelæ of such in joint affections. Also when tendons or muscles lie closely on or attached to capsules and ligaments, *they* become adherent by matting, from extravasations of blood or inflammatory effusions; consequently the movements of the joint are impeded or become painful, conducing to ankylosis and deformity, and in severe cases, if the joint has assumed an abnormal position, the deformity may be permanently fixed by such PERI-articular adhesions.

The synovial membrane is formed of a layer of flattened cells—an endothelium—supported by a subsynovial areolar tissue. This layer is incomplete, patches occur without *any* endothelium over the areolar tissue. In the areolar tissue ramify the bloodvessels, lymphatics and nerves. It forms a loose layer lightly binding the actual endothelium to the capsule, and permits of a considerable amount of "play." As the synovial membrane is always more extensive than

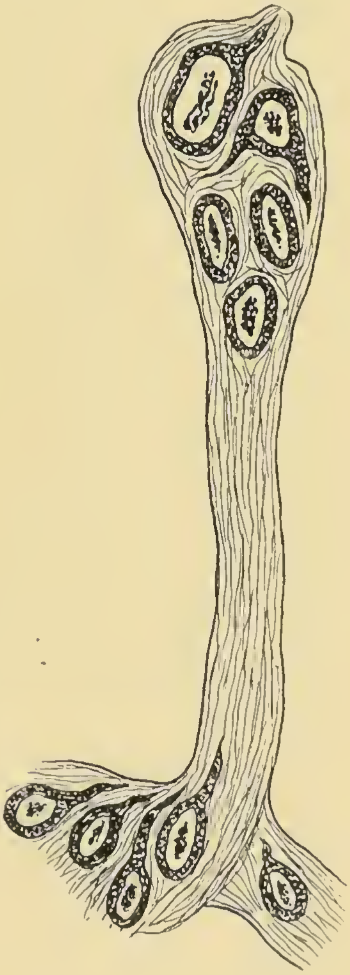

FIG. 5.—After Schäfer. A simple synovial villus magnified, showing the imperfect layer of endothelial cells. Frequently the villi contain embryonic cartilage cells.

the joint it lines, there is always some degree of plication of the membrane, whatever position may be assumed by the joint, and especially at places where it is reflected from one structure to another.

It covers all parts of a joint EXCEPT the actual articular cartilages ; it forms small folds and pockets, ridges and depressions, according to the surface covered ; in addition it exists as definite villi, which are of *three kinds* :—

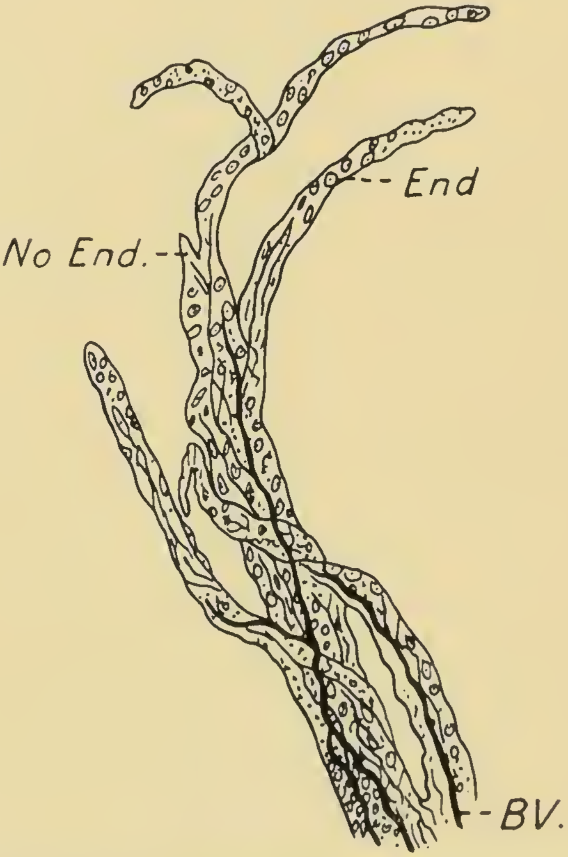

FIG. 6.—A compound synovial villus containing well-marked blood-vessels, *BV.* ; in places (End) endothelium is present, in others (No End) it is absent.

(*a*) A simple reduplication of endothelium, with the minimum of supporting areolar tissue.

(*b*) A reduplication enclosing in addition :—
- (1) An artery and vein with their peri-vascular lymph sheaths ;
- (2) Often a definite lymphatic vessel ;
- (3) A nerve filament.

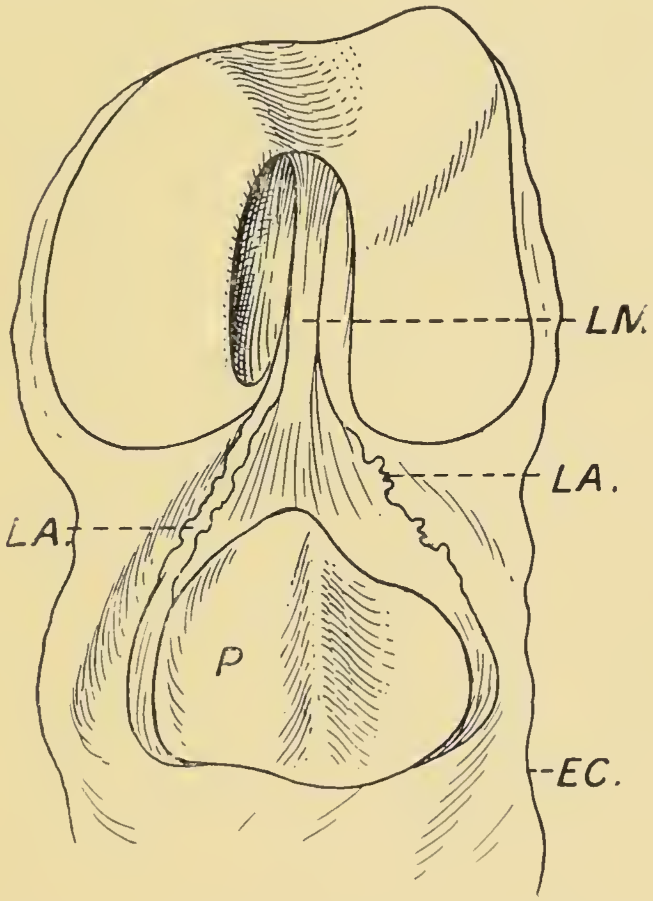

FIG. 7.—The knee-joint exposed by throwing down the patella, *P*; showing the synovial membrane extending across the joint from the lower part of the patella to the inter-condyloid notch in the form of a **Y**, the stem of which, *L.M*, is called the mucous ligament, and the villous edges, *LA.*, are called the alar ligaments.

(*c*) A reduplication containing a few residual cells, which when stimulated by trauma or toxins form a low type of cartilage ; the source of many of the “ loose bodies ” found in joints.

In the larger joints small fibro-fatty masses are found filling in certain depressions; these are covered by loosely arranged synovial membrane, and the whole often form small villous swellings, the glands of Havers, and when inflamed the villous processes enlarge and are a source of endless symptoms, as they get nipped during the movements of the joint and so exacerbate other symptoms or simulate internal derangement (slipped cartilage), or they develop into masses of loose bodies which act in like manner and occasionally get broken off and become fugitive foreign bodies; or they give origin to some of the tumours found in joints (lipoma arborescens, fibroma, &c.).

In other instances the synovial membrane passes across the cavity of the joint, extending in folds, "mucous or alar ligaments," from one bone to the other; when inflamed the free edges of these "ligaments" behave in the same manner as the villi and glands of Havers.

The synovial membrane gives a shiny, glistening white or grey appearance to the inside of a normal joint. The sub-synovial areolar tissue normally contains a large number of very small blood-vessels capable of intense distension, and when acutely or repeatedly inflamed the membrane assumes a bright pink appearance, and effusions of the severest plastic type (*i.e.*, lymph-forming) readily result.

Thus the importance of the synovial membrane is very great, both in health and disease.

In addition to the foregoing, the effect of this reduplicating of the synovial membrane in producing *adhesions* must be appreciated, the slightest acute exudation, *i.e.*, one capable of coagulating and forming pathological lymph (sero-fibrinous or fibrinous), or a hæmorrhagic effusion, causes two adjacent folds to unite together, or one fold to adhere to an adjacent cartilage, or bone, or capsule; AND WHILE THIS MAY EASILY BE BROKEN DOWN BY VERY EARLY MOVEMENTS OR MASSAGE, AND PERMANENT ADHESIONS PREVENTED, if left alone, as is so usually the case, the lymph, besides acting as glue, forms a scaffold into which the endothelial cells of the synovial membrane soon send daughter-cells (fibroblasts), which becoming fibrous tissue ultimately bind together *permanently* the folds of membrane which were stuck by the lymph, so that at this point the movements of the synovial membrane are impeded, it is thickened and distorted, its character and function perverted, and the part becomes permanently painful, or tends to produce a chronic effusion.

This process of early lymph adhesion so easily broken down, if taken in time, is rather like a moistened postage stamp, easily moved while the dextrin is moist, but so adherent once it dries.

As a result of repeated traumata, or chronic irritation of any kind, a similar tendency to adhesions is set up, but minus the scaffold formed by the lymph. In this case the irritation, generally toxic, excites the endothelial cells to proliferate, and the daughter-cells so formed produce prolongation and enlargement of the villi, or local thickening, or if two folds of the membrane remain in contact by PROLONGED REST they bridge over and thus permanently bind the folds together. The process is one of degree simply.

One aspect of this danger, not usually appreciated, is that played by œdema in setting up the foregoing changes.

To demonstrate my meaning: If a tooth-socket is severely inflamed—for example, the canine or first bicuspid—it is usual to find œdema *under the lower eyelid*, and in proportion to the degree of inflammation so the amount of this "collateral" œdema.

Yet the disease is not in the tissues of the eyelid or the cheek, but *in the tooth socket*, from which focus of toxæmia raised tension and impeded capillary blood flow and damming of the lymphatics result; hence fluid, by diffusing, extravasates into *adjacent loose alveolar tissue.* If this process is prolonged it tends to a chronic lymph œdema (this has frequently followed a single attack of erysipelas), in which proliferation of the endothelial lining of the lymphatics and capillaries takes part, and permanent thickening of the tissues results.

This process takes place frequently in connection with joints. I am convinced that the smaller flaccid effusions, so often seen in chronic rheumatoid arthritis (using the term comprehensively), and in some forms of syphilis, are collateral œdemas, associated with chronic osteitis of a rarefying character in the underlying and adjacent bone; the effusion takes place into the capsule, synovial membrane, and the joints, but is not *primarily* due to disease of these structures.

When the effusions are greater, and the tension in the joint increased considerably, then I assume a larger share in the pathological process is due to involvement of the synovial membrane and the soft tissues in the inflammatory or toxic process.

My point is that thickenings, adhesions, enlarged villi, &c., are so produced.

Inflammation.

As the pathology of all joint affections is principally that of INFLAMMATION, I will refer, without regard to the chemistry and abstruse questions, to the important points in inflammation.

In the process of inflammation changes occur :—

(1) In the blood-stream and blood-vessels.

(2) In the connective tissue of the part.

(3) In the essential elements of the structure involved (gland epithelium, muscle fibres, &c.)

In dealing with joints only the first two are involved, as *all* the structures implicated are forms of connective tissue (mesoblast).

CHANGES IN THE BLOOD-VESSELS.—Under any stimulus which excites inflammation, usually after a momentary contraction (shock), the vessel walls *dilate*, beginning at the capillaries. *This dilatation persists until recovery of the part occurs, or death of the tissue takes place.*

The *dilatation* is accompanied by :—

(*a*) *Acceleration* of the blood flow (HYPERÆMIA).

(*b*) If things are getting worse a *decrease* in the rate of flow follows (*retardation*).

(*c*) Then, after a stage of ebb and flow (*oscillation*), either re-acceleration and recovery follows,

(*d*) Or absolute cessation of the stream occurs (*stasis*).

If this is prolonged, thrombosis (clotting) takes place, and for all practical purposes the vessel ceases to exist ; it may, or may not, die.

During *acceleration* there is escape of plasma from the vessel into the lymph spaces—ŒDEMA ; and during its later stages, as also during retardation and partly in oscillation, blood platelets and leucocytes accompany the fluid.

The degree to which this takes place depends upon the intensity and character of the toxic irritation.

According to the number of blood-platelets and leucocytes which escape *and die* depends the nature of the exudate ; if it is chiefly plasma it is called a *serous exudate* ; if many cells escape and die, so coagulating the plasma, the exudation is called *fibrinous*. Practically, from the point of view of permanent damage to the *functions* of a joint, the distinction is important. If a small vessel ruptures or red corpuscles escape a *hæmorrhagic effusion* occurs.

Any interference on the venous side which raises the pressure in the capillaries, *in the presence of micro-organisms or their toxins*, results in stagnation of the lymph circulation in the part. If a coagulable exudate occurs a vicious circle is formed, and one cannot be surprised at the formation of a massive effusion into the joint and acute œdema of the articular and peri-articular structures.

Before considering the second series of changes it must be remembered that in addition to gross fibrous tissue (*a*) the actual walls of the blood-vessels, nerves, and lymphatic trunks consist of a considerable amount of connective (fibrous) tissue ;

(*b*) that *endothelium* in every part, whether forming capillaries, lining vessels (vascular and lymphatic), or forming a synovial membrane, IS the most prolific source and producer of those cells called FIBRO-

BLASTS, which form, with the escaped leucocytes, that collection called *round-celled exudation.*

Fibroblasts then are daughter-cells derived from :—

(1) The fixed connective tissue of the part.

(2) Endothelium.

(3) A certain number from wandering cells which exist in areolar tissue.

The power of PHAGOCYTOSIS AND REPAIR resides almost entirely in these fibroblasts.

By a lymph space is meant any chink unoccupied by cells or other structure.

Any deep area, other than a mucous surface, may become primarily inflamed in three common ways :—

(1) By direct introduction of bacteria through wounds, or by traumatism without wounds.

(2) By the conveyance to this area of bacteria, or their toxins, by the blood-stream — hæmatogenous infection.

(3) By direct extension through the lymph spaces, by continuity and contiguity of tissue.

When *bacteria are introduced by trauma* their products (toxins) diffuse in the lymph-stream, and stimulate or irritate everything they bathe—endothelium, connective tissue, nerves, blood-vessels—and either by such direct action or reflexly through the nervous system, the changes in the blood-vessels already described take place.

In *hæmatogenous infection,* when TOXINS manufactured in distant foci of disease are the cause of a local inflammation (by sapræmia, toxæmia), the part in all probability has become predisposed, *i.e.*, its inherent resistance is either very small or has been lowered by other deleterious agents, which in the case of joints are usually :—

(1) The nature of the joint, its situation in so far as it is superficial and badly protected.

(2) Excessive use and violence, or repeated small injuries.

(3) Exposure to thermal influences, cold, chills, draughts, deficient clothing, and occupation.

(4) Previous disease, and interference with the nutrition of the joint.

When *bacteria are conveyed to the part* by the blood-stream, they either exist in infected clots which lodge in the vessels as gross emboli or they are free and form minute bacterial emboli, and from these foci their toxins diffuse into the lymph-stream ; or they grow into surrounding tissue and spread, or, without forming emboli, they pass through the vessel wall into the perivascular lymph space ; these conditions are called septico-pyæmia.

In any case their toxins must diffuse ; an important difference between toxæmia and bacteræmia on the one hand, and gross embolic or traumatic infection on the other, is that in the former the plasma itself contains the irritants, whereas in traumatic infection the plasma is free from all irritants, as it is in the hæmatogenous infection, once the embolus is formed and bacteria are no longer brought to the part.

CHANGES IN THE CONNECTIVE TISSUE.

When a joint is infected and the lymph-stream is saturated with toxins the irritant may be so potent that when it gets into contact with the cells of the part it may instantly kill them—*coagulation necrosis*—

but if less potent, it (the irritant) serves to stimulate or irritate them.

All *synovial cells* are stimulated to excessive secretion, hence an excess of synovial fluid is formed; after a time the power of secretion lessens or ceases, and *reproduction* is excited.

The *connective tissue cells* are capable only of reproduction, hence daughter-cells—fibroblasts—are formed. These fibroblasts intermingling with the extravasated leucocytes form a mass of cells called ROUND-CELLED EXUDATION.

These fibroblasts are powerfully phagocytic, and their fate depends upon their ability to survive by overcoming the bacteria present. Those originating on the surface of the joint are desquamated into its cavity. Should they not survive, they with the leucocytes and other broken-down cells form the cellular elements in pus. On the other hand, should few or no more additional bacteria be poured into the area, the round-cell exudation becomes converted *by vascularization* into GRANULATION TISSUE :—

(*a*) Some of the fibroblasts elongate, &c., to form fibres.

(*b*) Others join on with the budding endothelium of the nearest capillaries, to form new capillaries, thus vascularizing the developing fibrous tissue.

Thus such repair as takes place is purely by the formation of fibrous tissue. It is POSSIBLE some hyaline cartilage may reform in this fibrous tissue; certainly an endothelial lining may reappear after the original has been destroyed if the joint is movable.

In arthritis this process of granulation tissue formation takes place :—

(1) *In the joints—i.e.*, on the surface of the synovial membrane, and results of necessity in great destruction of this membrane with resulting adhesions (see *ante*).

(2) In the substance of the sub-synovial areolar tissue and in any inter-articular ligaments.

(3) In the capsule and ligaments.

(4) Around the joint—*i.e.*, peri-articular.

I will not go into the bone changes (see Osteo-arthritis).

The *mode of reaction of the inter-articular cartilages* in acute inflammation is probably passive, that is, they probably die *en masse* by the cutting off of their blood and lymph supply; of course, this depends upon the intensity of the inflammation.

In a less acute inflammation they undergo more or less coagulation necrosis, and liquefaction (by peptonization).

The *articular cartilages* react in much the same manner as inter-articular fibro-cartilages; if the bony extremities to which they are attached are the seat of acute osteitis, the cartilages die, and then as granulation tissue or pus forms beneath they are eroded and liquefied in part, while portions are exfoliated into the joint, there to partly liquefy by peptonization.

Articulation cartilage matrix is in reality fibrillated, not homogeneous, and under the stimulus of a mild chronic inflammation always tends to become definitely fibrillated (see diagrams).

In *more chronic inflammations* (or ? degenerations) the cartilage cells enclosed in their capsules (see diagram) undergo cell division and multiply, the capsule bursts and the young cells, which are of very feeble vitality, are thrown into the joint cavity (as this process generally commences on the articular free surface) or they help to form granulation tissue—then a deeper set of cells undergo the same process, so that the cartilage becomes rough and occupied by small pits, and as the cell capsules are arranged in a series at right angles to the free surface, with intervening portions of matrix free from cells, a palisade arrangement results, and this roughness produces a characteristic creaking feel, and sound, on movement of the joint. Also all movements tend to *rub down* this surface and the cartilage may be completely worn away by the combined process and so expose the underlying bone surface.

If the *arthritis* is due to a progressive inflammation, such as is produced by tubercle bacilli, the granulation tissue into which the synovial membrane is converted extends along the surface of the cartilage and dips into these little pits, and so burrows deeper into the cartilage until the latter is perforated on to the underlying bone, and in this way the degenerating cartilage is replaced by tubercular granulation tissue.

An exactly similar process extends from the bony surface *when the bone beneath is the site of tuberculosis,* but in this case the granulation tissue finds an easy path in the plane *between* the bone and cartilage, where it spreads laterally and so detaches the articular cartilage, which is cast off into the joint when the granulation tissue breaks down by caseation. Both processes usually proceed simultaneously.

In *other chronic inflammations* of much less virulence, pathologists are divided as to how much should be attributed to degeneration, and how much to actual inflammation. For my purposes I include them as simply degrees of the same process, but refer to the degenerations under Osteo-arthritis.

In *these chronic cases* of mild virulence there is little or no actual coagulation necrosis of the tissue. The toxins (which generally produce these cases), or the number and virulence of the bacteria present, are so few or mild that the irritant serves not to destroy, but to excite cell proliferation, *i.e.*, *fibroblasts;* these are converted into fibrous tissue, so that all the structures become thickened and contracted and of low vascularity; gradually the cartilages disintegrate and disappear by atrophy, absorption, and friction. This process is best exemplified in chronic fibroid bursitis, when low-formed fibrous tissue $\frac{1}{4}$ to $\frac{1}{2}$ in. thick may develop in the walls of the bursæ.

In these cases gradual contractures form, from increasing disinclination to use the joint, and fibrous tissue contraction.

Another side-effect of inflammation in joints must be referred to before a distinct understanding of the many different results seen in arthritis will be appreciated:—

At the *periphery of the joint*, cartilage, capsule, synovial membrane and periosteum are more or less blended, and this part of a joint frequently shows *hypertrophic* changes—hyperostoses—while the rest of the joint is being eroded and destroyed.

An area of inflammation is like a fire. The centre is destructive, the near neighbourhood hot and extremely uncomfortable, while farther away genial heat is felt—that is, a GRADUATION exists.

In inflammation the toxins (comparable to the heat of a fire) diffuse, and according to their intensity and the distance away from the centre of inflammation so their effect; thus in cases which exhibit hyperostoses, *an osteitis exists,* at the periphery of the bone its toxins are non-destructive, they are capable only of exciting *hyperæmia, i.e.,* dilated vessels, good blood-supply, and active lymph-flow = *good nutritional supply* to the tissues. The attenuated toxins also directly stimulate the tissues to cell proliferation; this is rendered possible to an unusual degree by the co-existing hyperæmic condition of the vessels, and so there results excess of a low-type of cartilage, which becomes more or less calcified, and so hyperostoses result.

In time, as the general level of the joint wears away, these irregular hyperostoses tend to mechanically ankylose the joint by interlocking across the cavity.

THE ONLY WAY TO PREVENT THIS IS BY CONSTANT FRICTION FROM USE, AND BY MOVEMENTS AND MASSAGE WHICH MAINTAIN A SMOOTH SURFACE AND PREVENT INTERLOCKING. (See Osteo-arthritis.)

In my experience too great distinction is made between synovitis and arthritis. The former is considered to be an inflammation strictly confined to the synovial membrane, while by an arthritis is meant an inflammatory affection of all the constitutent parts of a joint or other parts than the synovial membrane alone. If one considers the question it is obvious that only a *short acute* inflammation can possibly involve the synovial membrane alone, as otherwise in the nature of things it must soon extend to the capsule, affect the cartilages and even the bone, if it is prolonged; thus *all chronic joint troubles are arthrites,* and only a few acute but not very virulent inflammations produce true synovitis.

Further, it appears to me that the cartilages must be looked upon as of primary causative importance only in a few traumatic affections, and then generally the inter-articular fibro-cartilages are at fault; the true articular cartilage is involved secondarily to the bone to which it is united, or by extension of disease from the synovial membrane on to its free (articular) surface.

The question of the deposits of biurate of soda in gout will be considered later (p. 103). In discussing synovitis therefore, as an entity, a certain amount of ambiguity and overlapping must be permitted.

The Diagnosis of Joint Diseases in General.

Diagnostic points may be specific or pathognomonic; or negative, *i.e.*, by exclusion; they may be collateral, *i.e.*, depending upon the evidence of disease in other parts of the body; or upon a definite history of preceding disease or trauma.

In the diagnosis of arthritis one of the most important elements in the process is that of the *patient*, I mean the consideration of him or her as a whole. I think a difficult case of arthritis will often only be elucidated by thoroughly examining the whole of the patient's body, and by an exhaustive history from infancy to the present time. To do this thoroughly may mean the calling in of expert assistance to decide definitely the presence or absence of disease in special regions of the body, and the help of radiography and bacteriology, *because it must clearly be borne in mind that except as a result of trauma, arthritis is only a symptom of a disease or diseases whose real nidus is in some distant part of the body.*

Not infrequently indeed the real DISEASE may consist of small multiple foci, either of which alone might be ineffective in producing the arthritis.

This is the real meaning of the statements so often made that the arthritic diathesis (*arthritism*) and chronic pulmonary lesions—for example, asthma—or arthritism and intestinal disorders are associated; *arthritism* is just an evidence of septicæmia (bacterial infection), or sapræmia (toxic absorption).

This applies in reality to all infections of joints usually met with, including tuberculosis, except that often we are quite unable to *localize* the primary tuberculous glands or nidus.

Occasionally an acute pneumococcic arthritis arises without pulmonary or abdominal pneumonia, and is then called a primary pneumococcic arthritis, but in these cases it is almost certain that there is an associated affection of one of the nasal accessory sinuses, or middle ear, which is *overlooked*.

The case of syphilis (and certain other diseases) is different; after the initial stage—primary sore—syphilitis *is* a septicæmia and has no *known* local nidus, but consists in polymorphic manifestations, of which arthritis is one.

To return to *the* patient; the presence of an urethritis, or a suppurating antrum, may be the only diagnostic points between two cases suffering from apparently identical joint lesions; but the one is gonococcal, the other septic, and before these cases get well the urethra of the one and the antrum of the other will *have* to be treated.

Thus the *differential* diagnosis may rest much more upon the associated lesions than upon the local joint condition.

So in my view two types of cases exist :—

(1) Those showing definite septic lesions of some portion of the body from which toxic absorption or bacterial dissemination may arise—the septic class. In a subdivision is placed the class of case having a definite history of *previous* septic lesions or specific infections. If a prolonged period has elapsed since such an illness or infection, many practitioners consider this precludes the association between the previous illness and the development of an arthritis. I cannot impress too much upon the fact that in a very large number of instances the effects of septic lesions may persist throughout a lifetime.

(2) *The second type of case* is the one which is free from the preceding conditions; let me call it the aseptic class. To make this distinction clear, take the following example :—

> Two youths of the same age, physique and social conditions complain of swelling and inability to use the limb without pain, some exacerbation at night, and general feeling of discomfort in the joint. On examination both shew evidence of a certain amount of fluid, and there is present evidence of arthritis in both; but *one has an active septic* lesion, let it be in the mouth or any part of the body; while the other is quite free from such; the joint lesion in the latter is almost sure to be due to a specific bacterium, namely, tuberculosis or one of the unusual causes of arthritis—typhoid, pneumococcus, &c.—and is of much graver prognosis than the joint in the septic youth.

If the "septic" lesion lies in the urethra, and is due to the readily demonstrable presence of gonococci, it is highly probable the joint lesion is gonococcal. While the presence of a scar in the neck dating from childhood, the origin of the abscess being unknown (*i.e.* not due to pediculi capitis, jaw lesions, &c.), or a prolonged "chest" attack of obscure nature may be taken as evidence of a tuberculous lesion and proof that tubercle bacilli exist in the patient's body.

This method of deduction is no more infallible than any other, but it is highly valuable, and much more often right than wrong.

Even if both the youths instanced were suffering from tubercular arthritis, the one having a septic lesion also, if this is curable, will bear a better prognosis than the one free from sepsis.

I am writing for those who will largely have to rely upon this deductive method, and who have no facilities for X-rays and the various pathological tests now used.

As I regard the bones forming the joint as the most frequent site of the disease, every joint offering any difficulty in diagnosis, or which resists treatment after a reasonable time, *must be subjected to a careful examination by the X-rays, and the radiogram itself*, not a photograph, must be relied upon in interpretation.

There can be no doubt that in chronic joint cases the diagnosis in *young people* lies chiefly between *tuberculosis* on the one hand and the manifestations of

Sepsis,
Rickets,
Congenital syphilis,
Coxa vara and
The sequelæ of paralysis

on the other.

In early adult life special forms of septic infection —gastro-intestinal and genito-urinary—are the most common causes of joint trouble, the gonococci, pure and mixed infections, taking precedence; then all forms of septic infection of the mucous tracts, tuberculosis being less common and syphilis (as distinct from congenital syphilis) being infrequent.

In late adult life chronic septic infection of the mucous tracts accounts for the vast preponderance of cases. In women the condition of the genital organs is frequently the overlooked source of infection.

After the cure of leucorrhœa, pyosalpinx, the removal of septic uteri, &c., also following removal of gall-stones, drainage of the bile-ducts, suppurating glands, and suchlike foci, complete disappearance of arthritic symptoms takes place.

I would specially call attention to the condition of the urine, not only for gross septic lesions, but for bacteriuria, phosphaturia, excess of indican, and other evidences of disturbed gastro-intestinal conditions. Chronic cystitis in men and women is very frequent, while the maintenance of post-gonorrhœal infections in the complicated genito-urinary apparatus of the male is now recognized as being indefinitely prolonged.

Too little attention is paid also to the condition of the chest; chronic bronchitis, mild forms of bronchiectasis, masses of old tuberculous glands, are certain sources of toxæmia capable of maintaining arthritic symptoms.

Hypertrophic pulmonary osteo-arthropathy is only a special manifestation of this view. (Arnold, "Secondary Hyperplastic Osteitis.")

Lastly, I must for emphasis put the condition of the *oral cavity*, in my experience by far the commonest source of arthritis. The absence of all teeth is a sure proof of many years of oral and gastro-intestinal sepsis, and when in these patients the desirable condition of a clean mouth is at last secured, many of their symptoms disappear or become much milder.

Carious teeth, crowns extending below the level of the gums, bridges, tartar, and gingivitis, form the usual features of a septic mouth. One must remember that the oral condition, while in itself serious, plays but the part of a laboratory, *infecting the whole* gastro-intestinal tract.

To *recapitulate,* the differential diagnosis of arthritis frequently depends not on examination of the local condition but upon the presence or absence of preceding or associated lesions in other parts of the body. Similarly, effective treatment demands above all *treatment and cure of the associated lesion.*

Causes of Synovitis and Arthritis in General.

These may be :—

(1) Local.

(2) General or systemic.

The local causes are :—

(1) TRAUMA, such as are associated with *blows* leading to contusion and hæmorrhage ; *severe wrenches* and other sprains ; excessive and violent movements of the joints ; dislocated cartilages ; nipped synovial fringes, loose or foreign bodies ; dislocations and subluxations ; fractures into joints ; separated epiphyses ; distortion associated with nerve and spinal cord lesions.

(2) DIRECT INFECTION by perforating wounds, stabs and shots, lacerations, compound fractures and dislocations. Post-operative.

(3) THERMAL influences :—

Cold is constantly given as a cause of synovitis, but it appears to me simply an aid in reducing the vitality of the part, so enabling toxins and bacteria circulating in the blood to become effective in the particular joint. Thus exposure to cold, damp, draughts, immersion in water is often the determining factor in the onset of a synovitis or arthritis. *Heat,* burns and severe scalds may without doubt produce synovitis.

(4) Extension of Disease from adjacent inflammations, epiphysitis, abscess, osteomyelitis (bone), bursitis, cellulitis, suppuration, &c.

GENERAL CAUSES.

There is not one form of infective or septic disease affecting the body which may not produce both acute and chronic inflammation of joints :—

(1) Thus any *local nidus of suppuration* in the oral or nasal cavities, as : septic gums, tonsils, carious teeth, rhinitis, and accessory sinus disease, middle ear suppuration, &c.

(2) Also acute or chronic infection of the *genito-urinary tract* : Urethritis, prostatitis, vesiculitis, cystitis, and nephritis, or vulvo-vaginitis, endometritis, pyosalpinx, &c.

(3) Puerperal sepsis.

(4) All forms of *gastro-intestinal diseases,* from gastritis or the mildest mucous-colitis, or a peri-anal abscess, to the gravest forms of ulcerative colitis.

(5) *Sepsis* in the bronchial and pulmonary system, from acute bronchitis or to the most chronic form of bronchiectasis.

(6) Every known specific bacterium has been proved

a source of arthritis: typhoid, gonococcus, pneumococcus, S. *erysipelatosis*, meningococcus, the bacilli of dysentery, S. *salivarius*, &c.

(7) The exanthemata and infective diseases common to childhood: Diphtheria, small-pox, scarlet fever, measles, &c.

(8) Acute rheumatism, which probably affords one of the best examples of acute synovitis. It is also associated with suppuration in joints, as one would expect in an affection which so frequently leads to malignant endocarditis and septico-pyæmia.

(9) The chronic granulomata, syphilis, and tuberculosis.

(10) Many diseases incidental to the Tropics.

(11) Lastly, any lesion, however small or unexpected, which may lead to septico-pyæmia, whether acute or chronic, has the capacity to infect a joint. One comes across such instances constantly.

As already stated, it must be remembered that a bacterial process may produce arthritis in two ways:—

(1) *By septicæmia or pyæmia—i.e.*, the bacteria themselves gain admission to the constituent tissues forming the joint, and therein excite active disease.

(2) As a result of the production of toxins in any local nidus of disease (*i.e.*, NOT IN the joint), these must circulate in the blood-stream, and thus *tend* to produce disease in all the tissues of the body.

If any portion of the body has its vitality sufficiently reduced by other agencies, such as over-use, trauma of a very slight nature, exposure to cold, &c., the toxins are enabled to excite *inflammation* in such an area, thus producing in a joint synovitis or arthritis. When we, therefore, attribute to cold and slight lesions the blame for a synovitis or arthritis, we must remember that in all probability they were only contributory to it, and SEEK FOR septic foci in other parts of the body.

It is highly probable that certain forms of toxæmia result from disturbances in the metabolism of food substances; especially it is maintained in case of excessive intake of proteids, and that such toxic bye-products play a part in maintaining or exciting the arthritic diathesis. That such toxins would help to produce disease is obvious from what has already been stated, but I have yet to be convinced that such errors of metabolism are UNCONNECTED with bacterial disorders of a septic nature in the intestine—*i.e.*, do they occur in absolutely healthy intestines and in patients entirely free from gastro-intestinal sepsis? From the clinical standpoint and practically I do not think so, as treatment directed to the septic condition invariably leads to relief or cure of the arthritis, while the dietary remains unchanged (see later, Gout, p. 113).

Whether a true toxic joint is common—*i.e.*, whether indeed it is ONLY the chemical poison which is present in and produces the lesion—is difficult to decide. It is highly probable there is a definite gradation in these cases, from the severest case in which the bacteria are demonstrable in great numbers down to the mildest form wherein no bacteria can be demonstrated.

It is well known in the case of tuberculosis of various parts of the body microscopical methods entirely fail in many instances to detect the presence of the tubercle bacilli in spite of the most careful search; yet a guinea-pig inoculated with a portion of the material investigated will die of tuberculosis, or show a definite tuberculous lesion when the animal is destroyed and examined *post mortem*; therefore the presence of the micro-organism is to be *suspected* in all cases of toxic arthritis.

SYNOVITIS.

SYNOVITIS may be *acute or chronic* (*hydrops articulorum*) ; the exudation may be :—

(1) Serous.
(2) Sero-fibrinous.
(3) Purulent.
(4) Hæmorrhagic.

The varieties merge one into the other, and depend upon the specific cause and general state of the patient.

The *common causes* :—

Local trauma resulting in sprains, contusions, ecchymoses, displacement of cartilages, or due to loose bodies or nipping of fringes, violent wrenches, exposure to cold and damp ; proximity of abscesses in head of the bones, &c. ; also tumours involving adjacent structures are said to produce effusions.

General associated with :—

(1) Gonorrhœa.

(2) Acute rheumatism.

(3) Secondary syphilis.

(4) Rarely due to the insidious onset of tuberculosis (hydrops).

(5) The mildest forms of septico-pyæmia.

(6) Gout is given as a cause, but gout produces a true arthritis and periarthritis.

(7) Scurvy, rickets.

Acute Synovitis.—*Clinical signs and symptoms.*

In examining a joint always Ask,
Inspect,
Palpate,
Fluctuate, and
Move.

These are the signs and symptoms of an inflammation in a cavity limited by a loose or taut capsule and ligaments, and having a synovial membrane which, on distension, assumes a more or less definite *characteristic* outline.

The evidence of the disease will vary with the amount of muscular and subcutaneous tissue covering the joint, also by the relation *certain* tendons and muscles bear to it.

Before commencing examination have BOTH joints equally exposed and placed symmetrically.

The ONSET is always sudden, and, if due *solely* to trauma, symptoms and signs develop almost immediately *from the time of accident*, depending upon the degree of the associated strain or sprain of the capsule and ligaments; whereas, if the trauma is only contributory to the action of the pre-existing toxins and circulating bacteria, a *short interval* usually elapses before the disease becomes pronounced—a matter of hours or days.

PAIN is usually the first symptom and varies in intensity; in true synovitis it soon attains a maximum, and varies from a dull aching to the severest throbbing, bursting sensation; it is relieved by rest and elevation, increased by all movements and jarring: the latter once experienced the patient thereafter is always very apprehensive of a repetition.

EVIDENCE OF TRAUMA in the form of bruising, laceration, excoriation, and hæmatoma may be present.

SWELLING.[1]—This is a constant sign and is soon apparent; it rapidly increases in degree and tension. It assumes a definite shape and situation, corresponding to the shape and outline of the synovial membrane; this, however, is only obvious in the superficial joints, wrist, knee, elbow, ankle, &c.; in the deeper joints general fulness and swelling only appear.

Local bulgings occur at any weak or unsupported part of the capsule.

The fluid in these acute cases is rapidly coagulable, but later loses the power of spontaneous coagulability; therefore at times the effusion does, and at others does not, communicate with bursæ which open into the joint, this being determined by the accidental closure of the orifices by plastic lymph quite early in the disease.

TENDERNESS may be very pronounced.

REDNESS.—Hyperæmia of the skin *may* be produced by treatment—fomentations, liniments, &c.—and not by the disease; but such is sharply defined, does not always correspond to the outline or agree with the maximum swelling present; the skin is usually hypersensitive, *i.e.*, to light pressure, which is not increased by firm pressure; generally the degree of palpable heat over such an area is less than that due to deep-seated inflammation. Redness due to the synovitis does occur in severe cases.

HEAT AND ŒDEMA.—Both appear if the joint is superficial, otherwise they may be obscured; they are not marked in true synovitis, and the more pronounced they are the greater the probability that the affection has become an arthritis or was a suppurative process originally.

Œdema of a mild nature betrays itself on pressure with the finger-nail, or a narrow instrument such as the handle of a scalpel, and comparison of the resulting pit or furrow which one produces by equal pressure over obviously healthy tissue.

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[1] *Vide* diagrams.

Heat is best tested by laying the flattened fingers and especially the soft tissues over the *proximal* phalanges, on the suspected part, and comparing the sense of heat imparted with that on the corresponding part of the healthy joint. This must be carried out with the precaution of exposing both parts to the atmosphere for an equal time, or else, if the diseased joint is exposed during examination while the healthy limb is hidden under garments or bedclothes, a true comparison is not made.

FLUCTUATION is easily obtained in certain joints, and is important to elicit, as marked PERI-articular swelling may exist and simulate synovial effusion while little or none exists, or when present it may be due to thickening of the membrane or granulation tissue.

Fluctuation is obtained by firmly placing one or more fingers of *each* hand on the swelling; then while maintaining uniform pressure with the one hand the other exercises a rapid pressing movement on to the swelling. If free fluid exists the pressure is transmitted to the stationary hand as an impulse.

Fallacies.—Such impulse MAY be experienced if the (*a*) swelling consists largely of succulent granulation tissue, (*b*) or a soft œdematous growth, (*c*) or a sarcoma (*d*) across the bellies of the muscles. But they are easily distinguished by the fact that with free fluid the impulse is *equally felt* :—

(1) When the fingers are placed at *varying* distances from one another.

(2) And in all directions.

(3) With greatest intensity (in free fluid).

POSTURE.—All inflamed joints are held in the position of greatest ease, *i.e.*, not in the full extent of any one movement, usually semi-flexed (this will be referred to under the individual joints). It is generally a position which if rendered permanent will be an awkward one for the patient; therefore if the disease is likely to result in ankylosis or restricted movements this posture *must by early gentle manipulation, under a condition of complete rest, be changed into a more suitable one* for future use. This advice is modified by the plan of treatment followed.

The MOVEMENTS of the limb are gravely interfered with. *Active* movements, *i.e.*, those carried out by the patient, are often impossible, probably on account of the pain produced, and because in a tensely distended joint they are prevented mechanically by the tension of the fluid.

Passive movements, those carried out by the practitioner, if very gently, slowly, and *uniformly* carried out, may show a fair range, and the ability to perform such movements over a moderate angle is of value in diagnosis as a means of excluding:—

(*a*) Grave injury to the joint bones by trauma.

(*b*) Showing absence of destruction of cartilage, *i.e.*, suppurative arthritis.

(*c*) Some accompanying internal derangement.

(*d*) Slipped tendon, &c.

If the trauma has produced much stretching or rupture of ligaments (sprain), especially *inter-articular* ligaments, some *preternatural mobility*, *i.e.*, movements of an abnormal nature, will be discovered when the effusion and pain are lessening.

Loss of movement in any ONE direction, such as inability to completely *flex* or completely *extend* the joint, must be particularly noted, as such results, as a rule, from some specific lesion of which the synovitis is an accompaniment, especially (*a*) internal derangement ; (*b*) foreign or other loose bodies ; (*c*) synovial fringes ; and the condition is not a simple synovitis.

ABNORMAL SENSATIONS.—Creaking, jerks, crepitus, are the peculiar things felt in certain joint conditions. In acute synovitis they are *absent*, but during the subsidence of the disease and as a sequela of fibrinous effusion creaking may be felt.

In true synovitis therefore this is negative. It is often wise to listen with a stethoscope, if palpation leads one to think there is any roughness in the movements of the joint.

REFLEX CHANGES IN THE MUSCLES acting on joints ; these are :—

(1) Spasm.

(2) Atrophy.

Spasm is present in every acute condition which occasions pain on movement, and is a conservative measure to relieve symptoms. It is therefore common to all joint affections, but its *presence* helps to exclude acute bursitis from the diagnosis.

Atrophy may be present, but is much less pronounced in all forms of synovitis than in arthritis ; but it develops too rapidly even in these cases to be due to disuse, and is stated to be due to reflex central changes in the spinal cord, or spreading neuritis. (See Arthritis).

The general signs are :—

(1) Those of fever.

(2) The presence of an associated lesion.

The fever is mild and generally no shiver or rigor ushers in the attack as commonly occurs in acute suppurative arthritis. Temperature, pulse, and anorexia are moderate, and generally tend to subside rapidly if the patient is put to bed and kept comfortable.

If the associated lesion is pronounced, a rigor and marked constitutional signs may develop, and the condition may be grave, as in acute rheumatism, but under these circumstances one does not usually consider the synovitis an entity.

To recapitulate, there is generally a history of a cause, an acute onset, with pain and swelling; the local signs of inflammation of moderate degree, the swelling having a definite outline corresponding to the synovial membrane, with the limb kept in semiflexion, but permitting gentle passive movements. Also the fever and constitutional signs are mild; in fact, the severer the local and general signs the more improbable a simple acute synovitis.

The Pathological Condition.—The *effusion* is usually serous or slightly turbid (fibrin flakes), but the early fluid is always coagulable; it may be fibrinous or hæmorrhagic and richly albuminous, its quantity varies. Occasionally yellowish gelatinous masses of lymph float in it, and its removal by a small trocar and cannula is often impossible for this reason. The presence or absence of lymph is important from the point of view of adhesions and return of the joint to its normal state. Microscopically it may be free from cellular element and consist largely of synovia and serum, but endothelium, leucocytes, fibroblasts, and red corpuscles may be present.

The *synovial membrane* is injected, pink-red, swollen, œdematous, at times ecchymosed, the villi and fringes particularly are affected and appear gelatinous; if slightly affected they still glisten, but often are dull and opaque, or even obscured by lymph in the severer infections, and small necrotic areas may be seen.

The capsule and ligaments are slightly hyperæmic also and tend to be softened, so that severe movements which would stretch them must be avoided.

The Treatment of Synovitis in General.

We must, according to my experience, separate the cases into two classes:—

(1) *The septic cases—associated synovitis*—that is, those cases in which the synovitis is part of or secondary to an associated lesion of a septic or infective nature. Even if trauma or thermal influences enter into the causation of the local lesion, the important factor is the associated lesion, and however able may be the local treatment of any one attack, its CURE ultimately will depend upon removal of the septic lesion. If this is neglected disappointment and dissatisfaction will result, progress will not take place or be slow; perhaps, indeed often, in spite of local treatment the joint condition will retrogress and ultimate results are bound to be bad—recurrent attacks, stiffness and limitation of movements as the result of pain or adhesions, or flail-joints from relaxed or flaccid ligaments and wasted muscles, or the development of those changes found in osteo-arthritis, fringes, pedunculated villi, loose bodies, &c., result.

(2) The *aseptic* cases in whom there is no associated

lesion, the inflammation of the synovial membrane alone claiming attention. These are usually traumatic in origin, and are really severe sprains.

Generally authors make a great point in treatment of *when* one is called in: how soon after the injury or the onset of the synovitis—*i.e.*, they modify their treatment by the amount of effusion which has taken place, and point out indications accordingly. If there is very little effusion they strap or apply pressure in other ways or apply constant cold to the joint, or they use or do not use a splint, and so on.

The method of treatment I use has *no counter-indications* in real synovitis, it is applicable to all stages and conditions—except in severe traumatic synovitis (sprains) leading to hæmorrhage into the joint or peri-articular tissues, in which only lies counter-indication, and then for a short time, twelve to twenty-four hours, at most. (See Sprains.)

The Indications for Local Treatment:—

(1) To relieve pain.

(2) To limit the effusion—*i.e.*, to check the inflammation.

(3) To promote rapid absorption.

(4) To *prevent* adhesions.

(5) Restore full and painless function to the joint.

I will describe my own practice and then refer to other methods.

Pain is relieved:—

(1) By absolute rest in bed.

(2) The immediate application of a Bier's bandage.

The patient is put to bed. I consider *absolute rest in bed* far superior to half measures in all ACUTE lesions of joints, both of the lower *and upper* extremity; on the contrary, I believe firmly in the ambulatory method of treating ALL CHRONIC joint affections.

In bed absolute rest, with elevation and a constant temperature, is possible; mental and physical tension is relaxed; one can lay the limb in any position upon pillows and can do away with splints, as I teach that splints *as used* are the most dangerous remedies we employ for acute joint affections, and must only be used under exceptional circumstances.

With the limb placed in a *position of rest* on pillows, to which it may be lightly bound or on which it may be retained by sand-bags, the spasm of muscles relaxes and a good posture may be attained at any time and the patient's local and general comfort greatly increased. Under these circumstances the patient will make many small movements, involuntarily, which tend to keep the muscles and tendons in good order, and avoid atrophy, prevent adhesions and stiffness, stimulate absorption, and in every way hasten recovery.

A rapid recovery—*i.e.*, the conservation of time—does infinitely more to obviate the sequelæ of inflammation in joints than is generally recognized.

Next to rest in bed the one measure above all others to be adopted is the application of a *Bier's congestion bandage.* It is the most powerful remedy I know in acute cases, both in relieving pain and to promote recovery with full use of the limb.

If the practitioner is familiar with this method of treatment and can adjust the bandage to perfection *nothing* relieves the pain of an acute joint more effectively, but otherwise it is best not adopted till he has secured such experience.

Further, and probably as a result, it enables passive movements to be carried out much earlier, and this means a great deal in a severe case.

In this respect it is an adjunct in diagnosis, as thereby the necessary manipulation to exclude other possible lesions may be carried out more freely and with best result.

In doubtful and important cases where it is ESSENTIAL that a correct diagnosis be made, it may be deemed necessary to give an anæsthetic, but before doing so Bier's bandage should be applied and carefully graduated, and in successful cases it may render this course unnecessary.

There is no doubt the method does require experience, and the personal factor of the medical attendant, in so far as this is concerned, may make or mar the value of the treatment.

For the technique see Bier's bandage, p. 470.

The bandage must produce œdema, and should be worn for a maximum of twenty-two hours, but its position must be changed two or three times during this period.

During the interval when it is not worn *all or almost all the œdema must be removed.* This is effected by elevation, massage, and elastic pressure, and when this is effected the bandage is reapplied, generally within two hours; but it may take three or four hours, if subsidence of the œdema is slow.

Within half an hour of the application, often much sooner, but occasionally only gradually after tentative applications and removal, pain is considerably relieved, and now *passive* and *active* movements may be carried out without real pain *if distension is not severe*, and in some cases quite free from pain.

This EARLY *passive and active movement* is of the utmost importance; it prevents the sticking together of the synovial folds by the plastic lymph which forms the early adhesions which lead to permanent loss of these folds, and to painful and restricted movements; it promotes absorption and the restoration of complete function.

The *movements* must not, and need not, be excessive; during the first few hours they need be carried through a few degrees only, gradually increasing on the second occasion, *just before the congestion bandage is removed*, and each day the range of movement is increased until within three or four days almost full movements of the joint are possible. If it is possible to execute the full range of movements early it is always desirable to do so, as this usually proves there is no complication present, and makes certain no adhesions exist.

Massage.—When the bandage is removed the œdema in the limb must be removed completely by stroking movements aided by elevation, and when this has been effected the Bier's bandage is reapplied.

As it is beneficial to secure good nights free from pain, without the aid of narcotics, the time the bandage is removed should be so arranged that by bed time all œdema has disappeared and it is time to *reapply* the bandage. This permits the patient also to move his position in bed without pain and *fear*, and to perform the involuntary movements usual in sleep.

By these means the inflammation so rapidly subsides that in three or four days deep massage, friction and kneading is possible; the swelling diminishes greatly, stretching and softening of the capsule and ligaments, and changes in the cartilages are prevented. *If the lower limb is involved*, in about ten days the patient is allowed out of bed, wearing the bandage but without putting any weight on the limb, and he may, on the second day, begin to get about, using a stick or crutch, but this must be cautiously carried out, as a very slight strain will suffice to bring on an acute exacerbation. Gradually increased use is made of the limb, and by this simple method in the greater number of cases of even severe synovitis complete restoration to health takes place in three weeks.

The bandage and massage, however, must be persisted with for another two or three weeks, and undue strain and fatigue of the joint avoided.

All manipulations of the limb or the patient (nursing purposes, &c.) should be carried out while the Bier's bandage is on.

Hot-air baths and douches help greatly in promoting absorption of the inflammatory effusion.

The weight of the bedclothes must be taken by cradles or some device. The First Aid plan of a hoop of metal cut into two and crossed diagonally and tied where they cross is an excellent plan.

In the case of the hip, for which it is impossible to use a Bier's bandage, the following method (advocated by Mr. Whitelocke, and which is referred to under Sprains), is probably the best plan to adopt.

If one of the joints of the *upper extremity* is affected, after two or three days in bed the patient may be permitted to get about, the forearm being supported in a broad sling.

A general rule always to be followed in joint affections is that all *unaffected joints* of the involved

limb are to be actively exercised, irrespective of the active and passive movements of the affected joint itself.

This rule is most important and cannot be too strongly insisted upon. It maintains the muscles and tendons in good condition besides preventing atrophy; it prevents slight deformities of the foot especially, and is the only real physiological means of maintaining all the tissues in a functional condition.

It is certainly superior to massage, by which it is to be *supplemented*, not replaced.

Alternative Treatment.

In case the practitioner is unfamiliar with Bier's method, or for some other reason prefers to treat the case without a bandage, the following plan may be followed.

Unless compelled to, from any cause, in every case avoid putting on a splint; put the patient to bed with the limb slightly flexed and elevated, and comfortably placed on pillows.

Apply Warmth and Pressure.—I always avoid moist heat; fomentations are used only to cleanse the skin over doubtful parts or if abraided, and then only for a limited time, after which a sterile gauze dressing is applied.

Dry Pressure Method.—A layer of cotton wool, 2 to 4 in. thick, preferably the unbleached gray wool, is wrapped round the joint and extending well beyond its limits; it must be quite smooth and free from hard places; this is bandaged over by means of a fine FLANNEL bandage, as tightly as the patient will permit, the only guide it is necessary to consult being his sensations, as it is almost impossible to do any harm over THICK LAYERS of gray wool; the bandage cannot be too tight, short of producing increased pain. *See that the joint remains slightly flexed.* As in putting on plaster dressings, the bandage must not come to the actual edge of the wool, which projects as a cuff above and below.

A small dose of morphine may be given to relieve anxiety and pain.

After an interval, varying from three to eight hours, this dressing is removed, the skin is dried, and massage by the gentlest stroking is carried out for five minutes, and after an interval the firm dressing is reapplied for another six to twelve hours. However inconvenient it is to see the patient often, an attempt must be made to see the patient and remove the bandage twice in the first twenty-four hours, not only for treatment but to reconfirm the accuracy of the diagnosis.

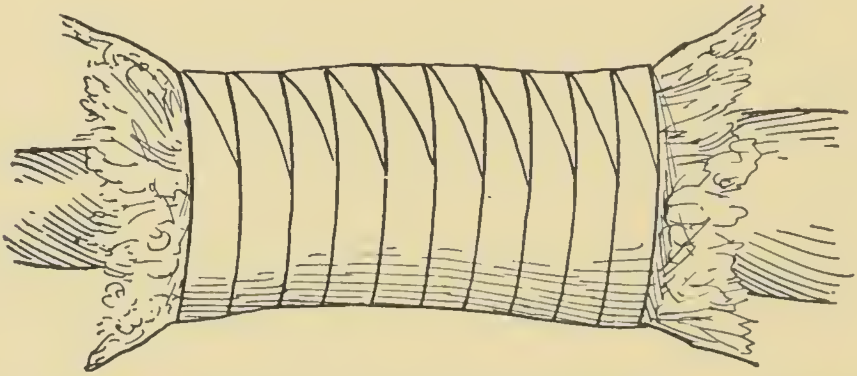

FIG. 8.—The gray wool compression bandage applied to the knee. Note the cuff above and below.

It is highly desirable that the bandage compression be removed from the joint for *at least* two hours in the twenty-four.

If at the *first* removal you can induce the patient to make even the slightest voluntary movements in the joint it should be done, and the patient encouraged to do so at every redressing. If this is not possible, an attempt at passive movement must be made, *as it is of the highest importance* that lymph adhesions be prevented or broken down within the first twenty-four hours. I have found a *tight* bandage applied above the joint during the efforts at movement often permits this to be done with less pain.

This treatment is continued for three or four days, when, if all is going on well, friction and gentle kneading of the joint is now added; and if movements have been hitherto impossible, a serious effort must be made on the fourth day, by which time the effusion will have diminished sufficiently.

About the fifth day some form of counter-irritation or stimulation should be carried out; this must be very mild. An alcohol compress suffices admirably. Then the wool dressing is reapplied, and the movements and massage persisted in daily, with perhaps an occasional alcohol compress (see p. 95).

About the tenth to fifteenth day the patient should be got out of bed, *as too prolonged rest in bed* tends to stiffness and adhesion, and weakness of the muscles. He should gradually allow his limb to hang down, but for some two to five days put no strain upon it. In twenty-one to twenty-four days he should be able to bear his weight, and in the fourth week to walk, assisted by a crutch or other help.

The amount of swelling and inflammation, and the degree of pain, are the only reliable guides to follow; too rapid attempts result in exacerbations, and too prolonged rest leads to stiffness, and to atrophy of the muscles.

If about the tenth day fluid is still present in any quantity and progress appears to cease, a change in treatment may be made with advantage. The various forms of counter-irritation may be adopted; perhaps one of the best is by strapping the joint with diachylon plaster over Scott's dressing. The ointment (ung. hydrarg. comp.) is spread in a thick layer on lint which is laid over and just beyond the area of swelling in the form of strips; then the plaster strapping is applied, each strip slightly overlapping the other, and the whole extends 2 in. below and 2 in. above the swelling.

This is left *in situ* for three or four days; if the fluid has subsided the strapping will have loosened, and is then removed. The skin is cleansed with olive oil, and active or passive movements made, and stroking performed; then the ointment and strapping are reapplied, or the flannel bandage over wool is reapplied for twenty-four hours, and the massage and movements, &c., again carried out. This generally suffices to restart absorption. (For more obstinate cases, see Chronic Synovitis, p. 54.)

If *movements* are followed by an increase in the swelling they must be lessened or even discontinued, as this is an evidence that slight synovitis is being set up. As long as the early plastic lymph is broken down the first twenty-four hours or so, absolute rest may be permitted for some days after without the same likelihood of adhesions forming.

The most severe varieties of joint inflammation I consider to merit the name Arthritis, under which they are treated.

If effusions are very pronounced early aspiration is desirable.

Chronic Synovitis.—A name more applicable to the majority of cases would be *recurrent synovitis*, but under the following conditions a real chronic condition exists :—

(1) As a sequel to a neglected or badly treated acute attack, or in patients who are debilitated or feeble, or in an unhealthy general condition—*i.e.*, *acute become chronic*.

(2) Certain varieties of subacute onset persist for an indefinite period, and therefore are primarily chronic ; these are very frequently of gonorrhœal origin. Some are due to typhoid, and a certain number are of indefinite origin (some of the tropical lesions are examples).

(3) Further, in a joint which has been greatly distended by an acute serous effusion, the capsule and ligaments have been so stretched (and possibly softened) that abnormal mobility between the joint surfaces is possible, and a tendency to subluxation results. On certain occasions of greater strain an unusual tension is sustained by the synovial membrane, capsule, and ligament, which trauma is evidencd by effusion into the joint—*i.e.*, a chronic synovitis is apt to be set up.

(4) Occasionally adjacent abscess of bone or chronic epiphysitis is evidenced by an effusion into the joint.

(5) Similarly, in certain cases, the increasing deformities associated with rickets results in a chronic effusion—genu-valgum, coxa vara, weak ankles, &c.

(6) While secondary syphilis at times gives rise to chronic synovitis.

(7) It is also to be borne in mind that tuberculosis may be the real cause of a chronic hydrops.

In general it may, I think, fairly be stated that the true causes of chronicity are: (1) Overlooked distant foci of septic infection, and that the attacks are really rapidly recurring attacks. (2) If enlarged villi, loose bodies, and localized adhesions exist in the joint, they are subject to, and produce, recurring small traumata, and so maintain the synovitis. In fact, they are not cases of synovitis, but osteo-arthritis.

Clinical Signs and Symptoms.—The history of the case is important, especially previous attacks of synovitis and definite histories of trauma, or an account of imperfect recovery from a former acute condition, because a synovial effusion, chronic or very subacute from the beginning, may be the only evidence of a tuberculous or syphilitic process, which is steadily disorganizing the joint structures, and requires a totally different line of treatment.

There are two conditions very often complained of by patients who have chronic synovitis :—

(1) A sense of weakness and insecurity in the joint; they fear to climb ladders or to make any form of violent or unusual effort.

(2) A sense of sudden "giving," during which the patient may fall down, or at other times a "catching" in the joint, both followed by *swelling*. Both conditions are chiefly due to the excessive mobility resulting from the stretched articular supports. The catching sensation may also no doubt be due to synovial fringes &c., becoming nipped, or to the irregular movements of certain inter-articular tendons, or, in the knee-joint, to some displacement of the patella. Occasionally the "giving" is actually due to rupture of adhesions. In certain cases stiffness is a prominent symptom; other sensations felt in certain cases are creaking and

sudden snaps (these will be referred to under Osteoarthritis).

Otherwise the symptoms and signs are those of acute synovitis greatly modified. The signs of inflammation are very slight, except that of *swelling*. The *swelling* varies ; in some cases it is not very large, in others it may be extreme. I have removed 30 *ounces of fluid* from such a joint. Its *shape is not always* that of the normal synovial membrane[1], as owing to the stretching and distortion of the capsule it assumes an abnormal shape ; it encroaches upon the position of adjacent bursæ and pads of fat ; the latter bulge and appear to be part of the swelling ; especially is this so in the case of the subligamentum patellæ fibro-fatty bursal tissue (see diagram 71).

In the synovitis which begins chronically the bursæ which open into the joint cavity take part in the swelling, such as the subcrureus, the subdeltoid, and psoas bursæ, and result in swellings which may mislead one's judgment.

Some few cases of synovitis are fibroid or sclerosing when chronic.

Pain to a varying degree, but usually dull and aching.

Active *movements* are usually of normal range, and on passive examination with the joint in certain positions (usually semiflexion) some lateral or abnormal movement may be detected. If there has been much *thickening of the synovial membrane*, one may feel folds or thickenings roll from under the finger (really the thumb is usually used) over the edge of the bones or at reflections of the membrane. These, when localized to the inner part of the knee-joint, are sometimes mistaken for slipped cartilages, and are generally tender. (See later).

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[1] *Vide* diagrams of normal synovial outlines.

The pathological conditions may be gauged from the signs and symptoms; they depend to a great extent upon the character of the early effusion, as the actual fluid in these chronic cases is generally thin and serous, highly albuminous but non-coagulable, of a slightly yellow tinge. At times it may be much more viscid and gelatinous, such as would not run readily through the needle of a small syringe, while persistent fibrinous masses often float in it.

The *synovial membrane* may be but slightly thickened, somewhat roughened and opaque, or it may be greatly thickened with large excrescences and villous processes, (see Osteo-arthritis). The *cartilages* are usually considerably altered, especially at the periphery, sometimes thickened by a low form of cartilage growth or fibrous tissue, at other times thinned. Occasionally the greater portion of the cartilage appears to be changed into a fibrous tissue.

In the cases which follow micrococcic infection the whole joint cavity may be obliterated by thickening and adhesions.

In some cases true hernial protrusions of the synovial membrane through weakened portions of the capsule take place (Morrant Baker's cysts).

Often in actual practice the symptoms and signs of chronic synovitis and osteo-arthritis are indistinguishable. But if several joints are involved then the condition should be considered an arthritis, and not a simple chronic synovitis.

Treatment.—There are conditions of the synovial membrane which make it probable that a cure cannot be effected ; such are the cases in which the folds and creases which permit of normal movements have been obliterated by adhesions ; the synovial membrane is too small for the joint, or the membrane is stiff and thickened, or bound down to the bones or cartilages, or so incorporated by former adhesions with the capsule that movements cannot take place and pain is persistent. (These and *other complications* are treated under Suppurative Arthritis and Osteo-arthritis).

In ordinary recurring or chronic synovitis by far the best line of treatment is :—

(1) By hot-air baths or douches (see p. 500).
(2) Massage.
(3) In suitable cases by Bier's congestion bandage.

In chronic joints not due to the presence of bacteria nothing relieves symptoms so readily as placing the joint in a hot-air chamber ; this treatment generally admits of—

(*a*) Earlier and more painless—active and passive movements ;
(*b*) It promotes absorption ;
(*c*) It softens and relaxes adhesions, while
(*d*) It in every way increases the reaction and vitality of the muscles, nerves and joint structures.

The joint is subjected to the hot air for one hour daily ; it is then rapidly dried, firmly massaged for fifteen to thirty minutes, and active movement carried out, then a flannel bandage is applied as firmly as possible over gray wool, and the patient made to rest on a couch, *out of all draughts*, the limb warmly but lightly clad.

The treatment takes a good deal out of the patient and so must be followed by ample rest, and as these patients are often debilitated, good nourishing food and general toning up is essential. The hot-air treatment should be carried out in the morning if possible.

After the compression-bandage has been worn six or eight hours it must be removed, and gentle massage, chiefly stroking, carried out for five minutes or more.

After an hour's interval, during which the joint is protected from cold and chill, an alcohol compress is applied for two hours, then a quilted jacket or some other warm light garment is applied for the rest of the twenty-four hours.

For example, if hot-air treatment is carried out from 10 till 11 o'clock, then massage fifteen to thirty minutes, and rest until 12.30 or 1 o'clock, then the compression-bandage from 1 till 7 p.m. At 8 o'clock the alcohol compress is applied, and replaced at 10 o'clock by the warm jacket; the patient then retires to bed.

Towards the end of the acute phase douching with hot and cold water alternately may do much good.

Under such a *régime* rapid improvement takes place. The patient is not allowed to use the limb, except when the compression-bandage is on, and then not excessively, as in these cases there is little danger of new adhesions; this modified rest (without splints) is highly beneficial in restoring the stretched fibrous supports of the joint.

When this line of treatment is unsuccessful the most vigorous forms of counter-irritation, or even the actual cautery, may have to be resorted to, and aspiration or even arthrotomy and flushing out the joint may be needed. Removal of part of the thickened synovial membrane is at times resorted to.

ARTHRITIS.

Acute arthritis may be (1) suppurative,
(2) non-suppurative.

The non-suppurative cases are similar to severe attacks of synovitis, and the commonest varieties are due to acute rheumatism of a virulent kind, gonococci, pneumococci, accompanying the acute specific fevers, and penetrating wounds with slight infection.

The suppurative causes are :—

(1) Septicæmic or pyæmic ;
(2) Mixed infections ;
(3) Penetrating wounds ;
(4) Part of acute epiphysitis or osteo-myelitis ;
(5) Spread from other local suppurative conditions.

The Signs and Symptoms.—Those given are of an acute suppurative arthritis ; the intermediate grades are less severe and show some of the points described under Synovitis. Usually there is found some septic focus or a history of preceding illness is elicited. In the case of gonorrhœa, both in the male and female, this MUST be specifically inquired into, and an examination of the urethra and vulva, also the urine, especially in the male, must be made, and cultures or microscopic investigation carried out. This is highly important, as it bears on prognosis, the Workmen's Compensation Act, and other matters.[1]

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[1] See observations on page 24, and under Osteo-arthritis.

In children a history of falls and mild trauma is frequently met with.

There may be a penetrating wound, or a septic, extensive or deep suppurative process not extending into the joint may have existed previous to the onset of arthritis.

The onset is usually very acute, sometimes accompanied by a rigor, or invariably by "chill," and *intense pain* in the joint, which rapidly increases and soon attains a degree which calls for narcotics for its relief. Of course all degrees exist, but the pain is invariably very severe. The slightest movement makes the patient cry out.

Swelling is rapid and usually *diffuse*, it does not appear so obviously confined to the synovial membrane as in the degrees called synovitis, because rapid œdema and swelling of the peri-articular structures take place, and the outline of the distended membrane is obscured. The whole joint area will in the later stages assume an abnormal shape, and may be of immense size.

Redness (*i.e.*, hyperæmia of the skin) is *invariable* in a short space of time; not infrequently large distended veins appear. A dusky bluish-red or mottled appearance may exist and the skin be tense and shining.

The posture is indicative of the intensity of the lesion; not only is the joint semiflexed but the whole limb appears absolutely helpless, lying on its side carefully supported and protected from all jars or possible movements. The lower limb lies flexed and rotated outwards, *lying on its outer side flat on the bed.* If any movements of the body are made the limb lies absolutely still while the patient assumes a new posture—a case of a limb with a body attached.

On *palpation*, which is often not tolerated, so great is the dread of the patient and also the intensity of his pain, there is *great heat*, which may often be palpably throbbing. The hand experiences the sense of firm, tense, throbbing, hot skin.

The *œdema* is easily made out if the necessary manipulation is tolerated, also *fluctuation* obtained; but occasionally the œdema and tenseness of the distended joint obscures the fluctuation. The bony landmarks tend to be obscured in the suppurative varieties by the œdema and peri-articular swelling.

All function is in abeyance, the muscles are intensely rigid from protective spasm. Attempts at movement of a passive nature are absolutely resisted, and nothing will induce active efforts to be attempted. The very vibration of someone walking across the room may excite the severest apprehension in the patient.

The *wasting of the muscles* is extraordinarily rapid, but appears more so owing to the size and distortion of the joint. Thus the joint is indistinguishable as such, all depressions are obliterated, bony points hidden, the skin is such as is found over an abscess, and the cyanosed colour, distended veins and absolute helplessness of the limb indicate the gravity of the lesion.

General Condition.—This soon assumes that of asthenic fever; at first the face is flushed and hectic, but soon it becomes drawn and extremely anxious. The mouth and lips become dry, and covered with sordes, the tongue blanketed, then brown, the edges often red and papillated; respiration hurried, and often panting; delirium, profuse perspirations, or diarrhœa may occur.

The *temperature* is that of an acute infective process under tension, *i.e.*, any type and height of temperature may be present. It must be carefully observed, as in gonorrhœal cases, in spite of the very serious local condition, the temperature may only reach 99° to 100° F., though in some cases it is higher, generally then due to a mixed infection.

The *pulse*, at first full, strong, and frequent (80 to 120), gradually loses its strength, but retains its frequency. Here, again, my experience of gonorrhœal joints is that the pulse is *less disturbed than in any other* type of acute arthritis. If due to the pneumococcus the pulse frequency is generally great.

Owing to the intensity of the pain, the loss of sleep, the narcotics and interference with the natural functions, rapid prostration ensues, and the greatest care must be exercised in supporting the bodily strength.

The peculiarities of *gonorrhœal* arthritis are given elsewhere.

Pneumococcal infections are amongst the severest forms; the foregoing description applies to such an infection.

The *pyogenic infections* are the most frequent, and generally result in the greatest destruction.

Typhoid bacilli give rise to acute arthritis, but this is of a much milder type.

In *septicæmia* intense pain, absolute immobility, tenderness, and some degree of swelling occur in joints, and lead to the diagnosis of epiphysitis or arthritis; yet on exploration nothing is found. The only safe plan is to carefully watch the case for twenty-four or thirty-six hours, and if there are no objective signs of arthritis, the diagnosis of arthralgia may be made. The X-rays may settle the diagnosis. The cases are very difficult, as the first evidence of the septicæmia may be the joint pain, and as epiphysitis arises just in this manner one is tempted to cut down and relieve tension at the earliest possible moment.

In *pyæmia* affecting joints the process is *usually* much less acute. A joint or joints may in this condition fill with fluid almost painlessly, yet on incision purulent fluid will be found. Such joints are discovered "accidentally," often by a nurse, and it behoves the surgeon to be on the look-out for joint swellings.

In *septico-pyæmia* suppurative arthritis of the most virulent nature occurs.

The Pathological Condition.—As in acute synovitis, the *synovial membrane* becomes intensely engorged with plasma and extravasated leucocytes; excess of synovial fluid and inflammatory effusion takes place into the joint, depending upon the nature and virulence of the bacteria; coagulation necrosis of extensive areas occurs, patches of dense coagulated lymph and necrotic tissue form, which later become destroyed by liquefaction and peptonization.

In the non-necrotic areas the round-cell exudation becomes vascularized and forms granulation tissue, so that the dead areas are cast off and form small sloughs, some of which float in the fluid effused into the joint. In the severest cases (*i.e.*, the suppurative arthritis), the whole or portions of the synovial membrane becomes converted into granulation tissue, the surface of which (*i.e.*, towards the joint) breaks down and forms pus.

The *capsule and ligaments* are involved in a similar manner, but the changes are slower; softening, which is characteristic of acute inflammation, is a necessary corollary; so that the tension soon stretches the capsule and ligaments, and permits of abnormal movements or subluxation of the bones. Still later, in suppurative conditions, the whole of the articular soft structures are converted into granulation tissue exuding pus into the joint, which is now an abscess cavity. Then extension into the subcutaneous or peri-articular structures takes place by direct continuity and a peri-articular abscess forms; generally, however, the weak spots in the capsule give way, and extravasation of the inflammatory exudate or pus into the peri-articular structures takes place—usually with great relief to the pain and improvement of a *temporary* nature in the general physical condition of the patient, and a change in the outline and character of the joint swelling.

The *inter-articular cartilages* either necrose and become converted into sloughs, which liquefy, or are partly eroded and converted into granulation tissue, which finally becomes a mass of fibrous tissue and a source of the densest adhesions.

The *articular cartilages* may also undergo various changes, according to how and where the inflammatory process begun. The *surface* may undergo coagulation necrosis and liquefaction, or it may be attacked by extension of granulation tissue from the synovial membrane and eroded, and become replaced or converted into granulation tissue. If the bone beneath is diseased, the granulation tissue and the pus which forms spread in the plane between cartilage and bone, and exfoliate the cartilage, or the granulation tissue may erode through the cartilage, and so invade its joint surface (the usual mode an osteitis infects a joint). Thus, partly by ulceration and partly by exfoliation, the whole articular cartilage may be destroyed. Pressure erosion occurs at the points of greatest pressure. If the joint infection is due to acute epiphysitis in the later stages of its development, the cartilage invariably dies, unless the abscess which forms in the epiphysis rapidly finds an exit by some external route.

The *bone* may be the primary seat of an acute osteitis, but if not it may become inflamed by extension at the junction of capsule and bone by the periosteum, or through the cartilage by erosion. Sooner or later if the bone is laid bare it becomes carious and converted into granulation tissue; the result when repair occurs may be a direct bony ankylosis, or at the least an intense fibrous ankylosis, in which case secondary calcification or ossification is not infrequent. If both bony surfaces are eroded, bony union is inevitable, as no preventive movements are possible in such a joint, the pain being too intense to permit of them.

Treatment.—According to the older methods, dense ankylosis with a fixed joint was considered to be the only rational termination to any acute arthritis, even if non-suppurative, except, perhaps, the condition as found not infrequently in infancy, generally due to inherited syphilis. With this end in view, absolute fixation of the joint, in the most favourable position for permanent use, was considered *the* first line in treatment, and the advice generally given was, *absolute immobilization of the joint in a splint.*

The newer methods of treatment aim at a *movable* *joint*, and strongly condemn all rigid apparatus; or, if on account of the pain and the extreme distension of the joint some form of apparatus is necessary, it must be such as can easily be removed *daily*, and its use must be discontinued within the shortest possible time. Also *early movement* is absolutely essential, and this is possible even in the worst cases under the modern methods.

Under the older methods of treatment extreme wasting of the muscles and peri-articular adhesions were encouraged. Now the maintenance of the tissues acting upon the joint in a condition of good health and function is known to be largely possible, and this aids greatly in the prevention of much pain and stiffness, which in themselves lead to adhesions and loss of function of the joint itself.

Many acute cases which would have terminated in suppuration formerly, are now quickly subdued and even free movement finally attained.

Now, as formerly, if there is pus present it must be let out at the EARLIEST OPPORTUNITY; but whereas the presence of a wound used to be an additional cause of adhesions, pain, and stiffness in the surrounding tissues, now it interferes very little with the progress and treatment of the case; indeed, with a wound active and passive movements of the joint are *utilized* to squeeze out the pus from the joint.

With a Bier's bandage earlier incisions may safely be made, even if pus be not found, as great benefit often results by relief of tension in the articular and peri-articular tissues.

The *first thing* therefore is to put the patient to bed, with the limb at a comfortable angle on a pillow, then *immediately* apply a Bier's bandage[1] as far from the joint as possible, and carefully graduate it, so that within half-an-hour definite relief to the intense pain is experienced. If such a compression is attained the outlook is favourable.

Then deal radically with any septic process existing elsewhere in the body.

The bandage is worn for twenty to twenty-two hours, but its position must be changed two or three times during this period, and it must produce definite œdema within three hours. At some period in the first twenty-four hours small active or voluntary movements should be attempted—however small, they do good. Also passive movements are to be carried out, as it is the principle of a stitch in time which applies to adhesions.

It is unnecessary to say that the gentlest possible handling only will be tolerated.

During the interval when the bandage is removed the œdema *must* disappear; this is effected by elevation and gentle massage. Gentle stroking has a soothing action, and is generally tolerated by the patient. Very soon, within two or four days, if the case is going to be favourable, signs of improvement appear in the intervals of wearing the bandage; heat and redness disappear, pain is lessened, and slight movements of a passive nature are certainly possible. Active movements may still be painful but should be tried. An effort may be made by the patient to change the angle of the limb, and this is then retained by manipulation of the pillows until the position becomes irksome and a new position is assumed. Active movements are the patient's best aid to recovering function.

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[1] See diagram p. 103.

If during the first forty-eight hours definite active or passive movements have been successful, but much pain is excited, one need not *press* them for the next few days, because the early lymph adhesions will have been broken down. Such a plan followed for seven or eight days is then, in the milder cases, supplemented by increasing the massage, friction and gentle kneading being tolerated.

If the œdema tends to persist apply pressure over a thick layer of cotton wool *to the whole* limb, including the inflamed joint; this is worn for four or six hours, and is followed by gentle friction with the hand. The Bier's bandage is then reapplied for a shorter period than formerly, say ten hours, when the pressure bandage is renewed, until ALL œdema disappears. Then the Bier's may be put on for the full period of twenty or twenty-two hours again.

During the second week the movements of the joint, both active and passive, are often possible over half, and in some cases almost the full range. Instead of the pressure bandage, occasional *alcohol compresses* over the joint are beneficial at this stage, the indication for use being a cessation in the rate of diminution of swelling.

In the third week in milder cases, and of course in the case of the arm earlier, the patient is allowed out of bed either with the Bier's or the pressure bandage on, and gradually use is made of the joint; at first only the *actions* of walking are carried out, then with the aid of a crutch or stick tentative use of the limb is made and increased gradually during the next week, until in the fourth week the patient may be able to stand on the limb. By this method even an acute arthritis may be cured in four to six weeks with *functional activity.*

Note very carefully that the rate of progress is not too forced, especially when the patient is allowed out of bed. It is *now* that relapse is so likely to occur. Having attained movements, a week or two spent in toning up the muscles and joint structures before resorting to full use of the limb is not undesirable if the case has been a very severe one.

In a joint going on to suppuration the same treatment is begun—namely, a Bier's bandage; but careful, very careful examination must be made of the joint at frequent intervals, both during the time Bier's bandage is on and during the interval, to seek for :

(1) Softening boggy areas.
(2) *Localized* painful spots.
(3) Local swellings, redness or heat.
(4) Maintenance or increase of the general physical signs.

It must be remembered that Bier's bandage protects the body against the absorption of toxins, and the developing abscess does not affect the temperature and pulse to such a degree as in the ordinary methods of treatment, therefore one must rely chiefly upon the LOCAL physical signs and symptoms.

As SOON as any sign of pus is observed an *incision must be made.*

By this method of treatment, however, such large wounds need not be made as if the ordinary treatment without Bier's bandage is being followed.

Incisions must be planned to drain the abscess cavity well, so that usually a small incision is made where the abscess points, and digital examination, with a glove on, made to determine the size and position it is to be extended in. *Generally* counter openings need not be made unless it is obvious they would act better.

DRAINAGE TUBES and GAUZE are never used to DRAIN *the cavity*. Sometimes tubes are inserted or a few layers of gauze applied to keep the EDGES of the incision from uniting too soon. (See Bier's Precautions, &c.)

Active and passive movements are used to help express the pus, and the latter may also be sucked out by the suction glass (p. 492).

One cannot prognosticate how good a result may be under Bier's, so the decision to *aim at* ankylosis must be arrived at after careful consideration only.

If the case is of some duration or old standing and has a sinus, the same treatment is used, supplemented by the suction glass over the sinus.

If a joint is quite disorganized or partly dislocated and adherent in a false position, then fixative methods are essential, but the nutrition of the muscles and rest of the limb must be carefully maintained by massage.

If any possibility of a functional result exists, then *partial fixation*, with daily removal of the splint, and massage, passive and active movements must be carried out.

As before stated, Bier's method may procure some degree of movement in even the most hopeless-looking cases, and therefore splints and other apparatus, other than a mild extension, should not be used in these old cases, except after fair trial without their aid, gross displacement excepted.

If the position is bad, or partial dislocation exists, the joint may be put in good position :—

The most gradual and least painful form of forcible reduction is that effected by Bier's orthopædic suction boxes (see p. 487).

(1) Under the sedative action of a Bier's bandage an extension apparatus is applied and a gradual attempt made to replace the joint in a good position.

(2) (*a*) Under general anæsthesia
    (*b*) Under spinal anæsthesia
    (*c*) Under local (ring infiltration) anæsthesia
    } forcibly.

(3) Or an open operation with partial excision may be necessary.

In varieties 2 and 3, when good position is attained, some fixative apparatus is necessary to retain the position.

(1) This may take the form of a splint.

(2) A hinged plaster of Paris mould—Croft's splint.

(3) An orthopædic apparatus—iron, poroplastic, leather, celluloid.

These may have to be worn for many months or years. In the upper limb *it ought never* to be necessary to use a splint; only very bad treatment or too early cessation of treatment, or neglect on the part of the patient, leads to such *absolute* fixation of the joints of the upper limb that an apparatus will be other than harmful.

Breaking down Adhesions.

(1) *Gradually by Extension.*—This is by far the best method to use if the adhesions are not too dense.

The method of application of a *fixed* extension is given under Tuberculosis (see p. 332).

The method of gradually increasing strain, or resistance by exercises, weights and elastic traction, or some form of mechanical exercises, gives good results without setting up increased exudation, or inflammation, into the joint.

The method, if left entirely to the patient, is likely to lead to self-deceit however, as it is useless for a patient to expect improvement by constant use of the joint within the range of movement it may possess; the movements must be attempted *beyond* this range, *i.e.*, they do no good until the adhesions are stretched, which is evidenced *by pain*, but as soon as the patients experience pain they cease their efforts, so that they never really put the adhesions under tension.

In conjunction with this method, in acute cases I employ the use of a Bier's congestion bandage, which is worn DURING the exercises, *i.e.*, the bandage is applied and the exercises immediately carried out, as they are then performed with less pain, therefore more freely and more effectively. The bandage is then removed and massage is carried out for eighteen to thirty minutes, and I apply an alcohol compress for a few hours as a mild rubefacient now and again, after which the joint is kept warm.

The patient is encouraged to use the joint for all domestic purposes. A patient who cannot get about on a recovering joint in the usual way will often feel great confidence and a sense of security when a Bier's bandage is worn above the flail-joint.

(2) *Forcibly*, under some form of anæsthesia (see Ring Infiltration, p. 73).

The disadvantage of forced movements is that they excite hæmorrhage and effusion in the joint, and unless passive and active movements are persisted in from the first, readhesion occurs and often the condition is aggravated.

As soon, therefore, as the fibrous bands are broken down, means must be taken to limit the hæmorrhage and prevent inflammatory effusion.

This is effected in two ways—

A. *By the use of cold and elevation.*

B. *By the immediate application of firm pressure.*

B *is more fully discussed under Treatment of Sprains*, which are practically produced by the treatment.

As firm pressure over a thick layer of wool is always possible I invariably employ it.

The use of adrenalin injected into the joint *previous* to the breaking down, and IMMEDIATELY followed by firm pressure, maintained for at least twelve and not longer than twenty-four hours, has been effective in preventing hæmorrhage in several cases in which I have employed it.

The *full* movements of the joint must be carried out after the bands are ruptured.

A. Personally I do not believe in the value of cold, as to be effective it must be uniform cold, and maintained constantly for twenty-four hours, at the end of which time its specific action as a hæmostatic ceases. Evaporating lotions are therefore not effective, and are irksome to apply and to prevent from soiling and moistening the bed and clothing.

The *icebag and Leiter's tube* are the more convenient methods.

It will be gleaned from the foregoing that severe potential suppurative cases may be converted into non-suppurative, and grave operations avoided, aspiration, with or without lavage, often effectively replacing open incisions.

When the acute stage is over absorption is to be encouraged; various methods of aiding this exist. Some of these are now seldom used, but are of real value, especially the use of leeches, which will often start absorption.

Depletion by means of leeches relieves pain and tension, and where aspiration of the joint is indicated a dozen leeches may be applied with marked benefit, and may obviate the need for aspiration—which it must be remembered is not always successful in withdrawing the thickened effusions.

Note.—Thorough cleansing of the skin and removal of all traces of drugs will be necessary before leeches bite, and as this is often very difficult on account of the pain and hyperæsthesia, it may be effected by plain fomentations, and finally by a compress wet with milk. Leech bites are not the most desirable of things about any acutely inflamed part, but if the part is dressed in a surgical manner till they seal by blood-clot, &c., no harm need result.

It is at times difficult to stop the oozing from leech bites; this may be effected by adrenalin or hazeline; if this is ineffectual a swab of cocaine is applied with the gentlest effective pressure, and the actual cautery used (a probe heated in the spirit-lamp) or a suture passed.

Aspiration or Puncture with Trocar and Cannula.—If the signs of inflammation are marked or the effusion great, or if it shows a tendency to remain unabsorbed, and the stretching of the capsule and ligaments likely to produce permanent weakness in the joint, *aspiration* should be carried out.

It needs a general or spinal anæsthesia, or it *can* be done under local anæsthesia :—

If a complete ring of skin above the joint is anæsthetized by injecting eucaine (or cocaine) into it, *i.e.*, endermically, the tissues below for some distance become insensitive and a puncture can then be made over the joint by a scalpel ; through the puncture the aspirating needle can be passed into the joint.

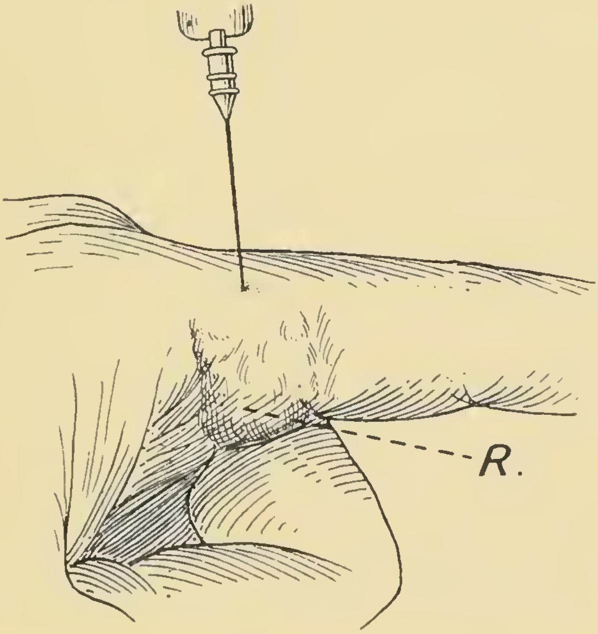

FIG. 9.—*Local anæsthesia* by the formation of a ring or zone of eucaine above the area to be manipulated. *R*, the infiltration. (After Lejars.)

Aspiration is preferable, as the character of the effusion is uncertain, and the negative pressure will suffice to remove œdematous lymph and fibrinous masses when the trocar would be ineffectual.

Three points need careful attention :—

(1) Absolute sterility of the instruments by boiling.

(2) The prevention of skin infection. This is

secured by making a puncture incision with a scalpel after the skin is cleansed, and thus obviating the necessity of forcing the needle through the septic zone —the skin. Cleansing of the skin is best effected by thoroughly swabbing the area with acetone or methylated spirit, or by painting it on two separate occasions with 2 per cent. iodine in spr. vini. rectif.

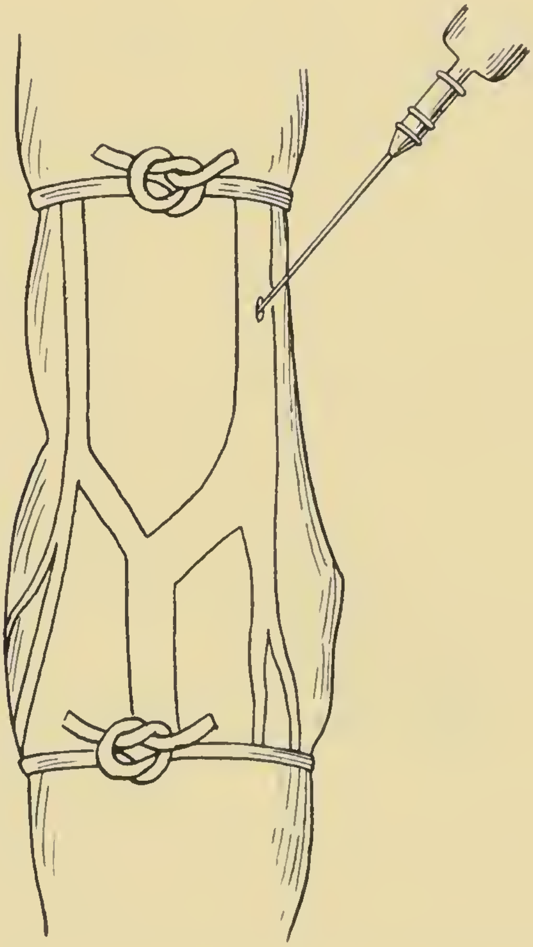

FIG. 10.—Bier's endovenous local anæsthesia.

(3) That the point of the instrument should not impinge on cartilage or bone.

After aspirating I have several times (with similar precautions) passed a second long needle into the joint and thoroughly washed it out with sterile saline (100°). Afterwards, if the shrinking of the skin is not sufficient to practically close the puncture, it may be drawn together by strapping, or by a strip of collodion gauze.

Then a 2 or 4-in. layer of sterile wool and a firm flannel bandage is applied and the limb elevated.

An injection of morphine is advisable subsequently. Massage should be carried out next day, and the Bier's bandage and compression bandage then worn alternately.

As, unfortunately, the *hip* cannot be effectively subjected to passive congestion, and the *knee*, one of the most frequently diseased and important joints, reacts least favourably to Bier's method in the milder type of case, the treatment by a congestion method may not be satisfactory, and other forms of treatment are demanded.

This remark applies to chronic varieties of arthritis of the knee; in the acute and suppurating forms I have had good results with it. The seriousness of this lies in the fact that by other forms of treatment we are compelled to afford relief to the pain by opium, and our local measures are so painful that very little can be done for seven to ten days, or more in many cases, to secure either passive or active movements. Also a splint may be rendered compulsory.

The cases, moreover, are too acute to be treated by the hot-air douche.

I am so impressed, however, with the necessity for movements being effected within forty-eight hours of the onset of an acute attack, or a little later if effusion is still RAPIDLY increasing, that I prefer to put the patient to sleep under a general anæsthetic, and VERY GENTLY make passive movements *sufficient* in the distended state of the joint to break down all lymph adhesions.

This must be done *very* slowly, so that no damage is done to the synovial membrane.

Very early movement is considered by practitioners imbued with the older views as unnecessary and dangerous in several ways. I only know that in my opinion I think it of the highest importance and that no condition of the joint except great distension contra-indicates it, and the more plastic or hæmorrhagic the effusion the greater the need.

It is in the less acute effusions that one can best afford to wait.

In a case of undoubted pyogenic infection, even of the knee, one may occasionally prevent and in all cases lessen the suppuration by Bier's bandage, and if it is already suppurating an early incision should ALWAYS be used, in spite of the facts stated above, and even if obliged to give up the Bier's bandage the suction glass may be employed with any other chosen mode of treatment.

In the case therefore of the hip put the patient to bed, with hip and knee semi-flexed on pillows, apply an extension with weights in the line of the FEMUR; in an adult about 4 lb. suffices at first ; this overcomes spasm of muscles and prevents the pressure necrosis of cartilages.

A Hodgen's splint, with the mildest degree of extension, suits very well, and is the best for nursing purposes, and for active or passive movements of the hip.

On the hip itself, over a layer of wool at least 3 in. in thickness, a spica bandage is placed; it chiefly provides dry warmth, as only very gentle pressure is borne at first; and an injection of morphine given. This absolute rest is maintained for twenty-four or forty-eight hours, when the gentlest movements of the foot and knee are made by combined active and passive movements.

If it can be tolerated the hip also is slightly flexed and extended after 48 hours.

Naturally in the severest cases incision at the earliest possible moment is necessary, with a drainage tube used for two or three days possibly; suction is used over the sinus daily.

The further treatment is similar to that of *acute synovitis.* Bear in mind that functional result is what is aimed at.

The Operative Treatment.—Much progress has been made in this department of surgery to secure movable joints by the grafting of cartilage, by the transplantation of joints, and by the interposition of soft structures which result in a pseudarthrosis.

Failing this desirable result, removal of sufficient bone, with the whole remaining synovial membrane, to put the limb in a good position for use, and wiring or pegging in this position, is the ideal to be aimed at.

SPRAINS.

In actual practice a sprain or strain is the stretching or rupture of fibrous tissue.

When the bones forming a joint are moved beyond their normal range, or such movements are violently resisted, or the bones forced into *abnormal* positions, the restraining ligaments and fibrous tissue (also the muscles) are either stretched beyond their physiological limits or they rupture partially or completely. Such constitutes a sprain or strain.

As the violence which produces these sprains may also result in contusions and lacerations of the synovial membrane, the severest forms of sprain are often accompanied by synovitis. Also in the case of the round cord-like ligaments it is not unusual for the bone or periosteum to which they are attached to be torn off, or in cases of violent injury for an epiphysis to be separated from the shaft, or for the bone to fracture into the joint. These constitute complicated sprains.

In like manner the violence which produces the sprain may lacerate blood-vessels or nerves, or produce fractures in the *shaft* of a long bone (not extending into the joint), or for the small bones of the carpus and tarsus to be compressed.

Thus sprains are divided into—

(1) *Simple Sprains.*

(2) *Complicated Sprains.*

SIMPLE may be—

(*a*) *Mild.* Generally as a result of overstretching with laceration of capillaries or small blood-vessels.

(*b*) *Severe.*

(1) Due to laceration and tears of ligaments and soft structures.

(2) Divulsion of the attachments of ligaments.

When sprains are COMPLICATED, either of the following may occur:—

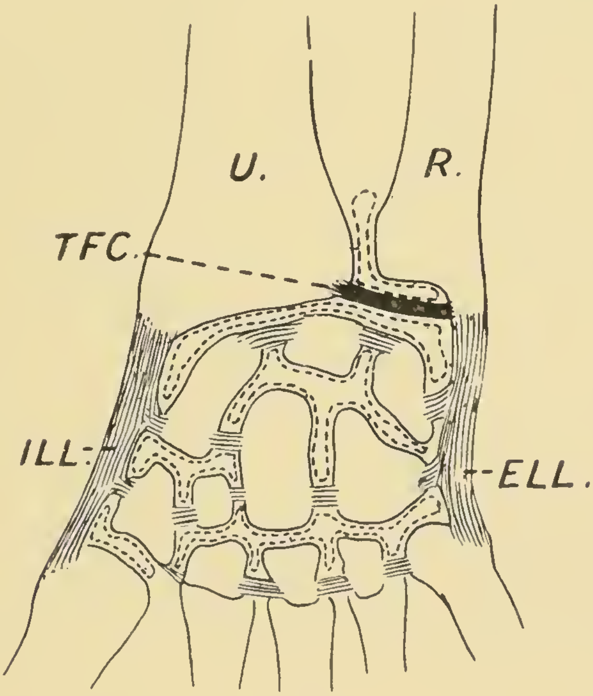

FIG. 11.—The *wrist in section* showing the synovial compartments and ligaments. *TFC*, the triangular fibro-cartilage; *ILL*, int. lateral ligt.; *ELL*, ext. lat. ligt.

(1) Divulsion (stripping up) of periosteum, or bone fragments may be torn away.

(2) Epiphyses separated.

(3) Subluxation of the joints.

(4) Crushing of bone.

(5) Fractures into the joint.

(6) Damage to articular or inter-articular fibro-

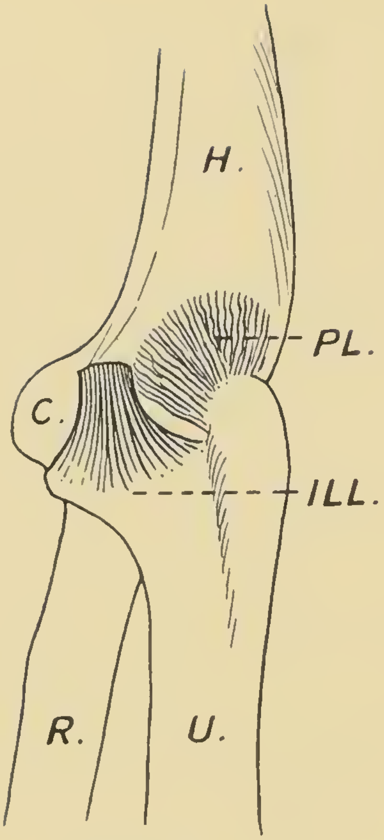

FIG. 12.

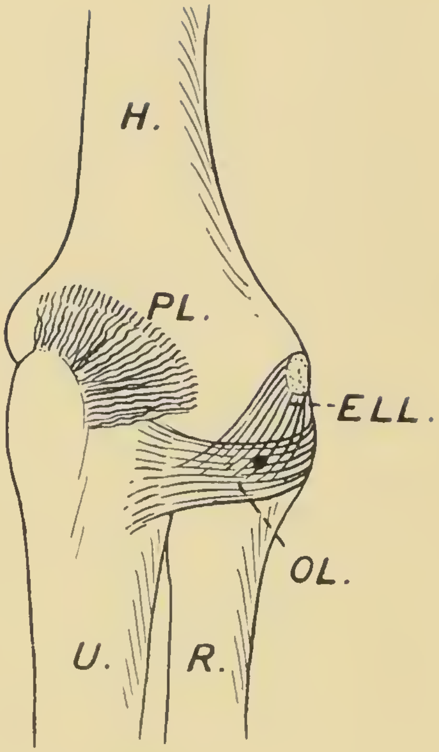

FIG. 13.

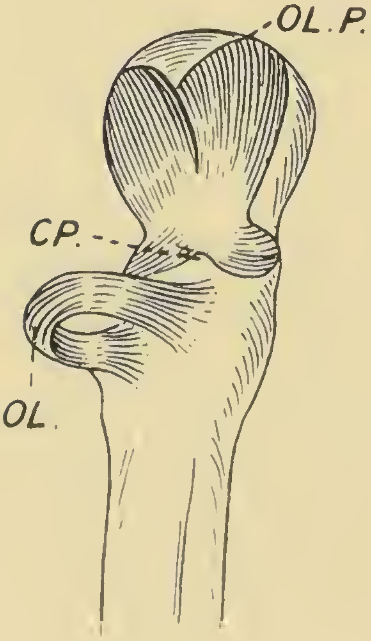

FIG. 14.

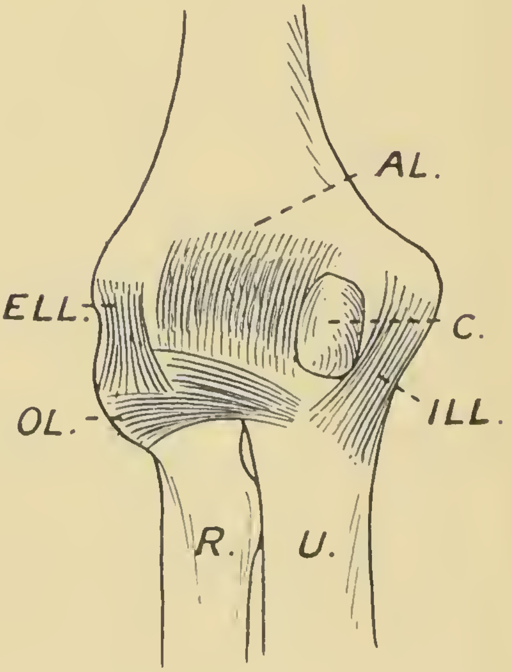

FIG. 15.

The ligaments of the elbow ana radio-ulnar joint. PL, post ligt. ; *ILL*, int. lat. ligt. ; *ELL*, ext. lat. ligt. ; *OL*, orbicular ligt. ; *AL*, ant. ligt. ; *Ol.P*, olecranon process ; *CP*, coronoid process. (After Quain.)

cartilages (internal derangement), or the violence may chip off a portion of inter-articular bone, and result in a loose body.

(7) Rupture of large blood-vessels leading to hæmatoma, diffuse extravasation, pulsating hæmatoma (traumatic aneurysm).

(8) Stretching or rupture of nerves, or divulsion of nerve roots.

(9) Rupture and laceration of tendons or muscles.

(10) Wounds.

Joints which depend upon the ligaments for their strength are very prone to sprains, while those which rely upon muscles are more frequently dislocated. The joints most frequently sprained are the ankle and wrist, but any joint may be affected.

OCCUPATIONS of a certain kind—gymnastics and athletics—are commonly associated with sprains.

The commonest forms of violence resulting in sprain are:—

(1) Severe twists or wrenches.

(2) Falls which result in forcing the bones into excessive or abnormal postures, or the sudden efforts to avoid falling.

(3) Slips, ditto.

(4) Severe muscular actions, especially such as are frustrated and uselessly expended.

PREDISPOSING CAUSES are:—

(1) Bodily or local weakness.

(2) Previous injuries to the same or other joints, which are consequently flail and result in insecurity during movements; or result in excessive usage of the normal joints.

(3) Rickets.

(4) Deformities.

SEQUELÆ OF SPRAINS :—

(1) Adhesions or ankylosis and stiff joints.

(2) Painful or flail joints.

(3) Osteo-arthritis.

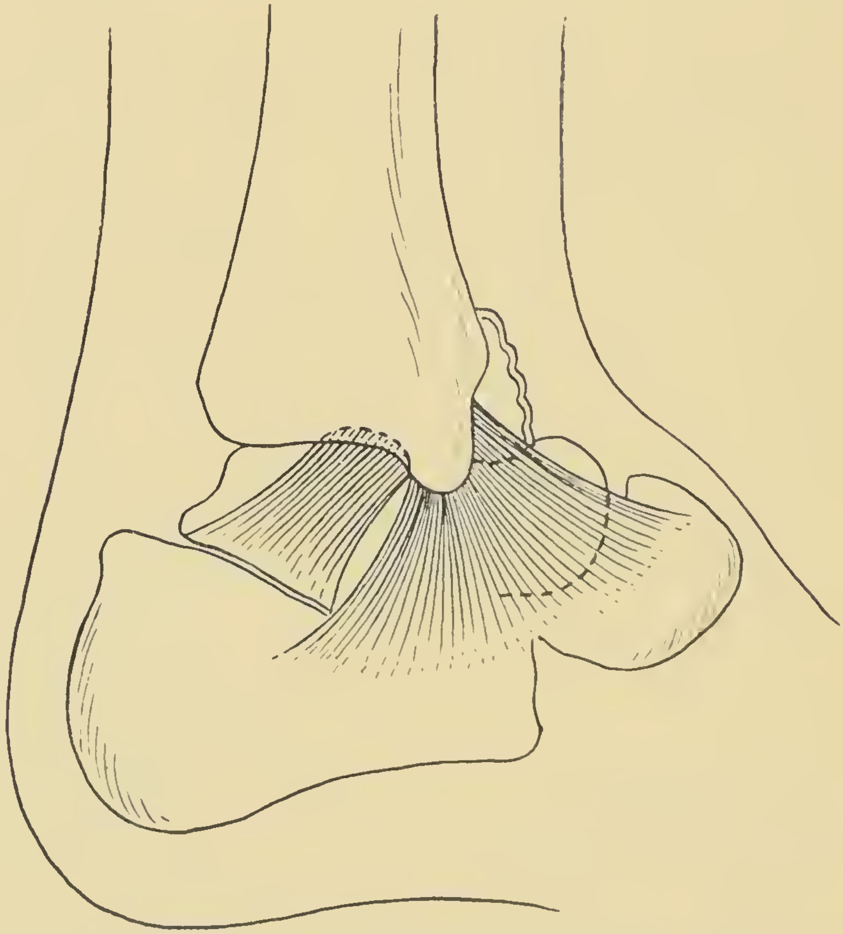

FIG. 16.—The internal aspect of the ankle showing the two divisions of the int. lat. ligt. (the deltoid ligt.), also the ant. ligt.

(4) The incidence of tuberculosis, septic infections, gout, &c.

(5) Deformities, especially in the foot.

(6) More rarely myositis ossificans, calcification of the capsule and ligaments.

(7) Involvements of nerve trunks or filaments in the scar tissue.

(8) *Tumours*, sarcomata.

As a consequence of or forming complications :—

(1) Internal derangements of cartilages.

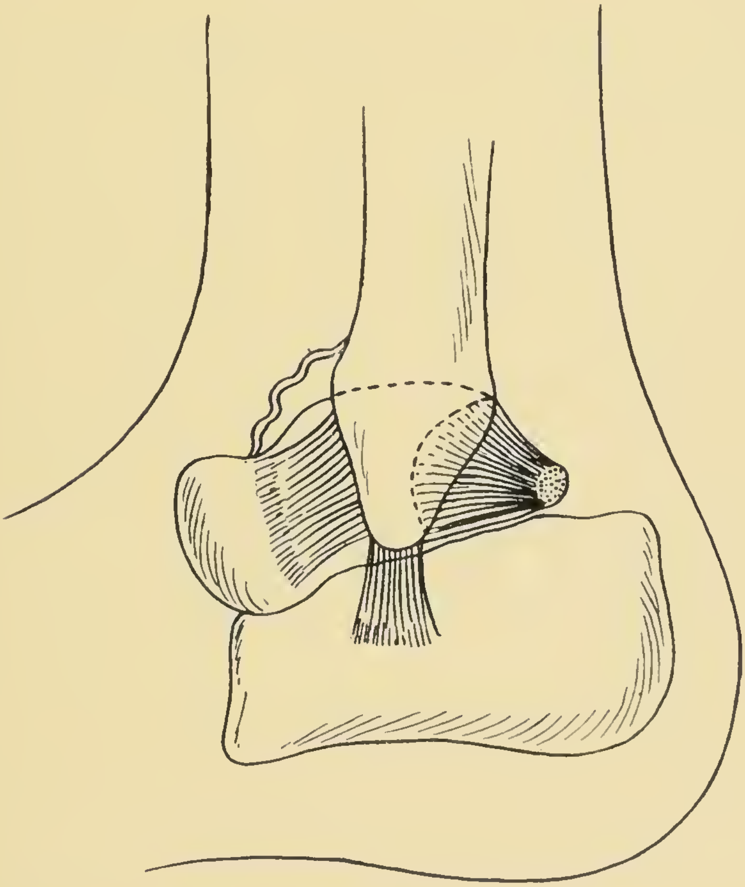

FIG. 17.—The outer aspect of the ankle showing the three divisions of the ext. lat. ligt., also the ant. ligt.

(2) Loose bodies : cartilage, bone, fringes—recurring synovitis.

(3) Neuritis, paresis, or paralysis.

(4) Wasting of muscles.

Adhesions and ankylosis are due to fixation in splints or to delay in beginning movements. In complicated cases, to partial dislocation, callus, gross changes in the articular structures (calcification, &c.).

Painful joints are generally due—

(1) To the presence of adhesions, whether intra- or extra-articular. (Adhesions, especially when recent, appear to be themselves sensitive.)

(2) Fringes and other conditions conducive to recurring synovitis.

(3) Involvement of nerve filaments in the scar tissue.

The pain varies considerably from time to time and is often worse when heat is applied and at night.

Flail joints and deformities are generally due either to imperfect repair from—

(1) Want of rest, so that the natural position of the bones is not retained when full use is made of the joint;

(2) *Or* to softening and relaxation of ligaments and tendons during the stage of inflammation.

(3) Stretching of the soft structures by prolonged distension.

(4) Atrophy of muscles.

(5) Far more often due to a fracture or separated epiphyses (*coxa vara, genu valgum, talipes planus*).

Recurring synovitis is always due to adhesions, loose bodies, fringes, and other intra-articular injuries, or to the intervention of osteo-arthritis, gout, &c.

Atrophy of muscles occurs to some degree in all joint affections. When it is excessive it is due partly to disuse, AND ESPECIALLY WHEN SPLINTS ARE USED, but chiefly to some change or changes in the nervous mechanism; in bacterial joint lesions it is suggested this is an ascending neuritis. Pain is, perhaps, in some degree responsible, also gross lesions of the motor nerves.

Atrophy is avoided by graduated exercises against resistance, electricity, massage, counter-irritation; operative interference may be required in certain cases.

Neuritis is oftenest an evidence of the secondary changes in the joint mentioned above. It may be due to stretching at the time of injury, to compression of the nerve trunk by organized blood-clot and fibrous tissue, or to implication of nerve endings in the scar tissue forming the repair.

Myositis ossificans is due to calcification and true ossification in—

(1) Tendons and inter-muscular fibrous tissue of muscles inserted into the neighbourhood of joints and fractured bones,

(2) Or detached periosteum from which ligaments have been torn or from which bone has been divulsed;

(3) Hæmatoma into which osteoblasts derived from bone and periosteum have strayed;

(4) Extension of ossification into intra-osseous membranes to which muscles are attached.

The PROGNOSIS of sprains in young subjects must therefore be guarded, but in the simple varieties complete recovery is the rule, although tuberculosis not infrequently arises after these mild injuries.

The more severe the complication the worse the prognosis generally. If a ligament is completely ruptured, about six weeks is needed to effect efficient repair to enable ordinary strain to be borne, and even if operation with suture be carried out, it shortens this period but very little, as it simply insures correct apposition, repair being effected as usual by nature.

The Signs and Symptoms of Simple Sprain.—*The history of the case:* generally the patients suffer a considerable degree of shock, although this usually passes off quickly; not infrequently they feel sick and faint.

LOCALLY.—In the position of one of the ligaments there is *pain*, which varies from a dull, bruised, sore feeling to severe and prolonged pain; at the time of injury a sense of tearing may be felt.

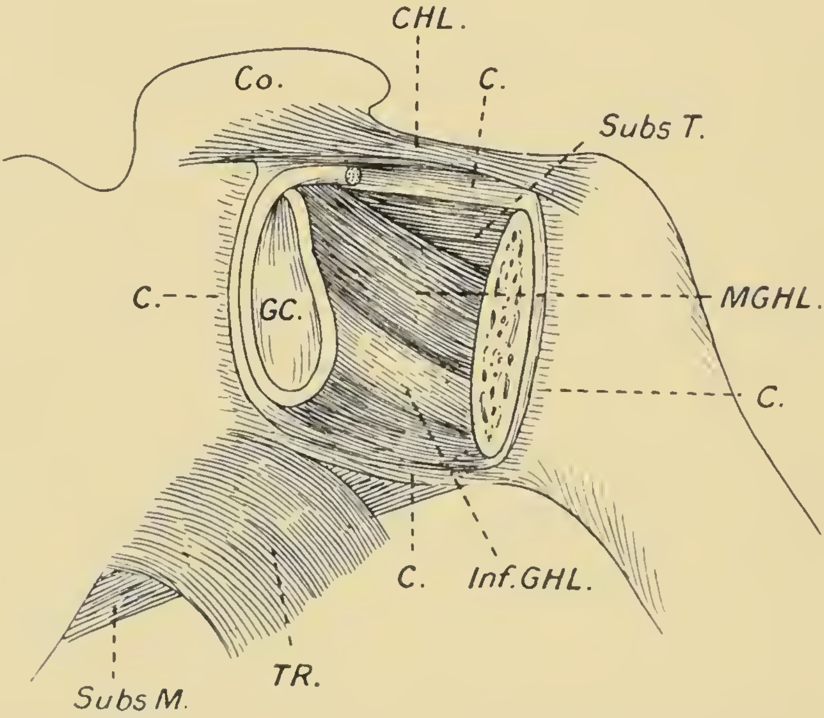

FIG. 18.—The *shoulder* looked at from behind, the posterior capsule and head having been removed. (After Quain.) *Co*, coracoid process; *CHL*, coraco-humeral ligt.; *C*, capsule; *Subs T*, subscapularis tendon; *MGHL*, middle gleno-humeral ligt.; *Inf.GHL*, inf. gleno-humeral ligt.; *TR*, triceps tendon; *GC*, glenoid cavity.

Stiffness and a bruised feeling with disinclination to use the joint. All movements which stretch the injured ligament increase the pain and soreness. As a rule *only slight evidence of trauma* is visible in the form of a discoloration due to a little extravasation, often not visible for twenty-four hours or longer.

On PALPATION the situation of the stretch or slight laceration is *tender*, there may or may not be some *swelling* or *slight irregularity*. The TENSENESS of the ligament may be decreased (if it is easily palpable).

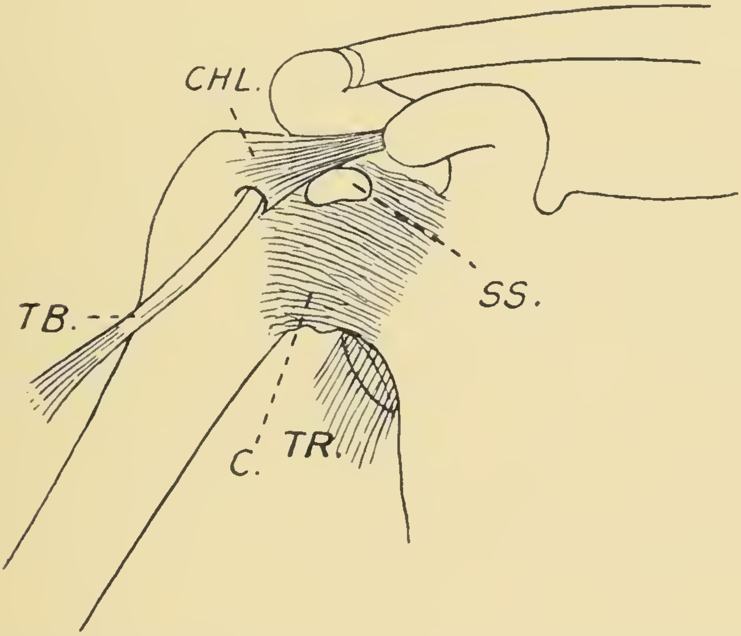

FIG. 19.—*CHL*, coraco-humeral ligt.; *SS*, aperture of communication between joint and subscapularis bursa; *TB*, long head of biceps.

In spite of the apparent simplicity of diagnosis the nature of the lesion may often be difficult to determine, especially in fat patients or muscular parts, and is arrived at by exclusion.

In a Severe Sprain.—In addition to the foregoing a snap may be felt or heard at the time of injury, and the patient may fall with a sense of receiving a sudden blow or "giving" of the joint, if the affected joint is in the lower limb. There may be a degree of helplessness felt, especially in the upper extremity, where the straining violence is often associated with traction. The actual joint may, for the time being, be rendered functionless.

On Examination.—There is generally *evidence of trauma* in the form of extravasation or bruising, and this may extend for a considerable distance above and below the joint. Some *swelling* over the lacerated ligament is also present, or a distortion in its outline, which can be more easily felt than seen. If it is entirely separated this may be evidenced by the *absence of the usual resistance.*

Generally the *tenderness* is marked and is situated over the point of attachment of the ligament, but may be at any part of its course. There may be intense hyperæsthesia. Such movements as would stretch the ligament are generally too painful to be tolerated; but if the joint is moved passively, and without putting tension on the damaged ligament, the range of movement will be good; it will be smooth and without creaks or crepitus (if the joint was previously healthy).

If there has been extravasation of blood into the joint there will be IMMEDIATE swelling in the synovial membrane; generally it is not extreme. If there is associated injury to the synovial membrane—*i.e.*, nipping and contusion, occasionally laceration, with only slight effusion of blood—there is little or no swelling in the joint at first, but within twelve or twenty-four hours *swelling increases* (synovitis) and may become marked. Generally it is of moderate degree but may feel very tense.

The *swelling* is then of a definite outline, corresponding with the anatomical arrangement of the synovial membrane; it fluctuates, there may be some heat and redness. The joint will be slightly flexed and movements will be impeded. (See Synovitis, Traumatic).

If the patient is the subject of an infective or septic disease the joint may become infected and may even suppurate.

Complicated Sprains.—It will often happen that the nature of the violence will lead one to diagnose "sprain." If this is severe and accompanied by considerable effusion into the joint, it may necessitate an anæsthetic (general or local) to determine, with certainty, that it is or is not a complicated sprain.

In young subjects wrenches and twists are now known to be prolific causes of linear fractures without separation (the periosteum remaining untorn), and these may extend into joints.

Further, partially or completely separated epiphyses and divulsed fragments of bones, or fractured malleoli, and other bony projections are quite frequent. While in the carpus and tarsus, complete dislocations occur which are masked by pain and swelling. In an intricate joint like the knee, displaced semilunar cartilages are possible.

If a fracture into the joint or a partial separation of an epiphysis at the epiphysial line is present, the usual advice is to treat the complication primarily and the sprain incidentally.

I wish strongly to deprecate this, and while remembering the existence of the fissure in the bone or the separation of the epiphysis, it will be much wiser to treat the sprain as a *severe sprain*, and never to use a splint or a fixative apparatus if it can by any means be avoided. *These cases above all others demand early and constant movements to prevent ankylosis or firm adhesions.*

When performing these gentle movements the epiphysis or bone should be firmly supported. Sufficient rest to secure union is afforded without splints, unless, as sometimes but fortunately rarely happens, the epiphysis is considerably separated from the shaft, when operation is demanded.

Differential Diagnosis of Complicated Sprains.—If one sees the case before marked effusion occurs, recognition of the complication may be possible. This depends upon :—

(1) The unusual site of pain and tenderness, which will correspond to the epiphysial line or well-known bony points, or be at a distance from the joint.

(2) The abnormal condition of the usual bony landmarks as compared with the uninjured side. Increased *width* between malleoli, condyles, and styloid processes should be carefully sought for.

(3) The presence of roughness, and especially crepitus of a harsh nature. Crepitus is often absent, but if tried for in every direction it is generally elicited, especially *by the use of the stethoscope.*

(4) Interference with the movements of the joint only in a *certain* direction or position, or catching of the joint, or limitations which are not explained by the presence of pain only.

(5) It is unwise to a degree not to obtain an X-ray photograph of any severe lesion in the neighbourhood of a joint, and at least two positions should be taken, Never accept a screen examination alone, always obtain a radiogram.

(6) In the *carpus and tarsus* any sprain which does not readily respond to treatment, and go on to a complete recovery, is either :

- (*a*) The seat of a fracture ;
- (*b*) or is infected by some secondary process—osteo-arthritis, or gout most frequently, occasionally syphilis.

(7) *Nerve lesions* are indicated by :—

- (1) Paresis or paralysis.
- (2) Interference with sensation, numbness, hyperæsthesia, &c.
- (3) Tingling, formication.
- (4) Pain in the course of the nerve or at a particular spot.
- (5) Wasting, *i.e.*, atrophy of muscles.
- (6) Changes to electrical tests.
- (7) Deformity.

Note.—If in any doubt give an anæsthetic or use regional or spinal anæsthesia, especially if the case is not seen early. This will be of benefit to the patient in another way besides ensuring a more accurate diagnosis, as thereby you may move the joint throughout its full degree of action, which breaks down very early lymph adhesions, and is said to restore curled up, torn structures to a more normal position, and if a displaced cartilage or a loose body exist, will perhaps force it into a position where for the time being it will be least harmful.

Treatment.

In SIMPLE *sprain* the indications are :—

(1) Avoid further stretching of the damaged ligaments, fibrous tissue and muscles.

(2) Encourage return to normal state and strengthen the damaged part.

(3) Relieve pain and prevent avoidable complications.

In these cases there is little danger of intra-articular adhesions, so after carrying out the full range of movements of the joint, carefully and gradually, for diagnostic purposes, MODIFIED REST may be more rigidly attained without the risks attending it in more severe cases.

In the case of the lower extremity this is secured by reclining on a couch and not attempting to walk. In the upper extremity this modified rest, *as opposed to absolute rest in bed*, wherever referred to throughout the book, is secured by supporting the fore arm in an Esmarch's triangular sling, and if the shoulder-joint, acromio-clavicular or sterno-clavicular joint is involved, by lightly bandaging the arm to the chest by means of a broad bandage.

Return to Normal State.—The best stimulus to repair is the maintenance of a good blood-supply to the part, also functional activity of the damaged structure, *short of producing strain* or increasing the lesion.

Therefore, while advocating modified rest, the joint must still be used, *i.e.*, its *movements* must be carried out gently at repeated intervals during the day by the patient's *active* efforts, and if from fear or other cause he will not carry this out, passive movements by the practitioner may be substituted, but are not so effective. These gentle movements are performed two or three times in the twenty-four hours.

This alone *maintains* the joint in good condition; it also stimulates the blood-supply and keeps the nerves and muscles in functional activity and fit for immediate use.

In mild sprains it prevents any matting of the periarticular structures which might otherwise occur.

Two methods of additional treatment will be mentioned.

The hot-air bath or douche will promote absorption of the extravasated blood and fluid, and should be used after the lapse of twenty-four hours in conjunction with the congestion bandage or any other form of treatment.

The FIRST is that which I consider far superior to any other in the treatment of all joint inflammations, namely, the use of a BIER'S CONGESTION BANDAGE. It stimulates repair and relieves pain, and when combined with massage and other measures it aids absorption. (See Synovitis and Arthritis.)

The SECOND METHOD is similar to that so ably advocated by Mr. Whitelocke, of Oxford. This consists in applying firm pressure over a thick layer of wool for a variable length of time, rarely exceeding twelve hours uninterruptedly, so that it may be removed, and the part gently manipulated and massaged at least twice in twenty-four hours. It is wise to employ an interval of at least half an hour, and better one to two hours, before reapplying the pressure, and during this time, electricity, drugs, massage, mild counter-irritants, the hot-air bath or douche, &c., may be applied if desired and the deep as well as the cutaneous circulation enabled to go through a stage of reaction. *It is now accepted that if hyperæmia or anæmia be induced in the skin the* DEEP PARTS *are similarly affected.*

I use a layer of grey unbleached wool, devoid of folds or lumps and as thick as can be conveniently manipulated. For a large joint like the knee or shoulder, this is *at least* two inches, better three inches, thick, and is in proportion for small joints, such as the thumb. The bandage is of soft flannel—domette is less readily available as a rule—and should be three to four inches wide for large joints, and two inches for smaller joints, and in proportion for still smaller joints. The layer of wool extends well above and below the joints treated, and the bandage must *never* cover it quite to the edge, *i.e.*, a projecting fringe or cuff about one inch wide must always show above and below the bandage, as is done with plaster of Paris casings.

With such a thick layer of wool great pressure may be applied without creating pain or doing any damage. Often acutely inflamed parts are relieved by it ; both the warmth and pressure play a part in its action.

For the first few days take off and reapply at least twice daily. During the interval gentle friction by stroking is directed to the *periphery* of the tender spot and to the muscles and surrounding structures.

Slight elevation of the limb is desirable when the bandage is off, and from the very first day active movements must be carried out, the stretched ligaments being supported by pressure with the hand. At first only such movements as do NOT call into use the damaged structure should be performed, if a choice exists, and the range limited to a degree short of producing pain.

After three or four days, more stimulating treatment is carried out during the interval, by increasing the force and depth of the friction and by kneading and rolling movements with the thumb. (It always appears to me that professional masseurs are too keen on early resort to DEEP massage.)

This may be effected also by the aid of mild counter-irritants. I find great benefit from an alcohol compress, consisting of two or three layers of lint saturated with methylated spirit, and covered by mackintosh and wool and bandaged firmly. It is applied for two hours instead of the pressure bandage, of which it is a modification. It is wise after its removal to expose the joint for half to one hour in front of a warm fire, and then to massage it before reapplying the compression bandage. The range of movement is now possible to a normal extent, and should be so performed.

In a mild case, affecting the lower extremity, such as we are treating, on the fifth to seventh day, if it is essential for the patient to be about he may be strapped with some form of strapping. I prefer diachylon plaster spread on *strong holland*; this is cut into strips from ½ in. to ¾ in. wide, and of sufficient length to surround the joint and each end overlap 1 in. Each strip is passed twice through very hot water before it is applied. This makes it more supple and it sticks well. After it is applied the strapped area is well mopped and dried with a towel; a soft flannel bandage is applied for perhaps twelve hours, after which it is removed. A certain amount of kneading can still be carried out through the strapping.

All sorts of strapping are recommended, and shaving of the hair advised. I feel quite satisfied with diachylon, and if this strapping is worn continuously for a week no folliculitis occurs if the skin is healthy and free from previous dermatitis, otherwise no strapping is really suitable, it can be removed also with very little discomfort. The skin is cleansed by swabbing with methylated spirit.

In more severe cases strapping may be applied (as in Scott's method) over thin lint or muslin, to which diachylon readily sticks.

In the Cases with Laceration and Hæmorrhage into and about the Joint.—The additional indications are to prevent further bleeding, and then to remove the blood before it coagulates, or promote its rapid absorption.

The best mode of checking further hæmorrhage is by rest, elevation, and firm pressure over wool, and by giving a morphine injection. This is far superior to cold, and has none of its drawbacks. After twenty-four hours all danger of further bleeding is over.

One knows how very slowly blood extravasations in the skin and subcutaneous tissue are removed; it is probable the synovial absorption is more rapid, but, although blood remains fluid for some time in a joint, it is many weeks before all clot is absorbed, which means a constant danger of adhesions, and slight synovitis from nipping of the blood-engorged villi.

After twenty-four hours, if the tension in the joint is considerable, I feel sure the best plan is to use an anæsthetic (general or local) and aspirate the joint (see Precautions, p. 73); then immediately apply the wool compression bandage and elevate the limb. It is impossible generally to draw off all the blood. If, for any reason, this is not done the duration of treatment will be longer. This first compression bandage is best retained twenty-four hours, then the usual intermittent method pursued. Early movements are *more essential* than in the mild cases.

Whitelocke does not believe in early massage, *i.e.*, not before seventy-two hours; but gentle friction and careful kneading with a thumb always appear to me advantageous if the *immediate area of damage in the ligaments is avoided*, as the presence of some coagulated blood *here* is advantageous both in retaining the damaged fibrous tissue at rest, and by contraction during clotting it draws them together and serves as a scaffolding for fibroblasts.

Splints are never really required, but if the internal lateral ligament of the ankle or one of the lateral ligaments attached to the styloid processes of the wrist is completely ruptured, a moulded poroplastic splint, which retains the foot or hand inclined towards the ruptured ligament, may be worn for seven days or more; it is removed, if possible, twice daily, and MUST be removed once, to enable gentle movements and massage to be carried out. The limb must be placed in a position in which no strain is put upon the ligaments when the poroplastic or splint is removed. It is easy to mould poroplastic to fit over a modified form of the compression bandage.

Hæmorrhage does not counter-indicate a Bier's bandage after twenty-four hours (Bier says after twelve hours).

If there is a Considerable Degree of Synovitis.—Aspiration or leeching is called for if the swelling is so large as to produce severe pain, and prevent movements, or is likely to lead to permanent relaxation of the capsule and a flail joint.

It is best to aspirate if the effusion is still increasing, and then to apply a Bier's bandage to rapidly allay the inflammation, which is the source of the effusion. (See Treatment of Synovitis, p. 42.) Leeching will greatly assist in reducing tension, but has very little influence in promoting absorption of blood. Local counter-irritants may be used.

The treatment of the actual sprain when great effusion is present becomes of secondary importance, but must not be lost sight of.

Avoid any movement which would increase the strain already put upon it. Support the part and apply pressure with the wool bandage; do not try to put the limb in a straight position, leave it in the position of greatest ease; as long as adhesions are prevented no injury will follow retention in *any* position.

Treat as described for mild sprain, but be most careful not to do any forced movement, and use very little deep massage for three or four days, *i.e.*, until the effusion begins to decrease. If this is delayed and aspiration has not been performed, or leeching with a dozen leeches resorted to, and Bier's bandage is not used, counter-irritation is to be resorted to, beginning with the milder forms (p. 48), and massage more vigorously carried out.

If there is any doubt about complications, anæsthetize and make sure that all the bony points are normal, and that no crepitus exists; also that no locking or limitation of movement of the joint in any one direction is present, and look for evidence of septic processes in other parts of the body, and exclude gout and syphilis, or treat these conditions.

The alcohol compress alternately with the greater pressure of the wool bandage is very useful.

If the *inflammatory signs are checked*, and the effusion is becoming chronic, a hot-air douche (see p. 500) or a hot-air bath will generally restart absorption; or ionization of iodides, or salicylates, or lithium may be tried.

When the condition is *chronic*, and will not clear up under hot-air, counter-irritants or pressure, it is wise to forcibly manipulate the joint under anæsthesia, in case adhesions of a loose nature, which only come into action in full or special movements, is the cause of the chronicity, then to renew the treatment as if it were an acute case.

After full trial of these measures without success, arthrotomy is indicated, and masses of lymph, fringes, loose bodies, or any other abnormality which may account for the chronicity removed—perfect hæmostasis is essential—and the joint closed with or without irrigation with normal saline.

In the relaxed condition of the capsule and ligaments, hot-air baths and douches, friction, avoidance of all strain, but never *absolute* fixation, are persevered with. Apparatus, which is easily removed, or strapping with diachylon over Scott's ointment, or hydrotherapeutic measures may be tried. Alternate hot and cold water douches, with occasional blistering, will often tone up the loose parts. Remember that tuberculosis and sarcoma are prone to follow mild injuries.

GOUT.

This, one of the oldest and formerly most prevalent forms of arthritis, is becoming a much rarer affection. Why this is so is not altogether clear, but certain facts are known which, to a considerable degree, explain its decreasing prevalence.

The *first* is dependent upon more accurate diagnostic methods, which have enabled us to weed out true gout from the various obscure or ill-defined arthrites which are not associated with the deposit of bi-urate of soda in the articular cartilage and other structures around a joint. That is, what would formerly have been termed a gouty joint we now class amongst the osteo or rheumatoid arthrites.

The *other* factors which have resulted in this decrease of true gout are connected with modifications of diet, hygiene, the increase of athleticism and outdoor exercises amongst all classes of society.

The **pathology of gout** is, I may safely say, imperfectly known. The foundation of the traditional pathology which stated that gout was due to an excess of uric acid in the blood has been so vigorously assailed as almost to have been extinguished. Indeed, a great deal of evidence is to hand which might enable one to state exactly the reverse.

While the bio-chemical controversy is still undecided, one cannot dogmatize, but from the result of my own experience and a careful review of all that has been written and done on the subject of gout, and above all as a result of the treatment of gouty patients upon the lines presently to be indicated, I think it may with equal safety be stated that the great class of joint cases included under the headings Osteo-arthritis, Rheumatoid arthritis and Gout are FUNDAMENTALLY due to the same cause—namely, to septic infection, more especially of the gastro-intestinal and genito-urinary tracts. (See Osteo-arthritis, page 116).

The differences between osteo and rheumatoid arthritis are purely artificial and depend partly upon the personal factor of the investigator ; to the general practitioner they appear one and the same type of disease, but in gout we have a notable distinction—namely, the deposit of biurate of soda in the cartilage and fibrous tissue of the joint.

The conditions which lead to this marked distinction need not, in my opinion, be differences *in kind* but solely in degree of the septic processes which underlie all these diseases and in the variable degree and manner in which the special organs of food metabolism are affected by the toxic processes.

It is certainly an easily demonstrated clinical fact that with very few exceptions gouty patients are all "septic," but just as in some cases the toxic substance called alcohol exerts its deleterious influence chiefly upon the nervous system, in others upon the liver, while still others exhibit well-marked gastro-intestinal symptoms, so may identical septic processes in different subjects produce different lesions. It is this unknown selective action to which I believe the distinction between gout and osteo-arthritis must be attributed. I would go further and state that a similar explanation holds for diabetes, and that the same septic process may in one person produce diabetes, and in another may result in gout or osteo-arthritis.

Clinically we know diabetes and gout are often associated, and to me this does not appear in the least strange. It depends upon unknown qualities possessed by the various organs and tissues what differing clinical manifestations result when they are exposed to toxæmia; the liver of one or the pancreas of the other may be highly resistant or markedly feeble in its resistance to toxic infection.

The food factor also bears upon this divergent action, while we are apt to entirely overlook the previous history of patients, especially the state of their health during childhood, during which important stage of existence grave injury may have been inflicted upon certain organs, so influencing their vitality and resistance as to *determine during later life* whether a gouty manifestation or a diabetic disease will be produced, should sepsis affect the patient in a persistent manner.

The infective diseases of childhood in all probability have a much more far-reaching influence upon the health in after years than we even now credit to them. Another point which has impressed me with regard to sepsis in the mucous tracts, and therefore bearing on this hypothesis, is the importance of remembering that in some patients sepsis in some form or another has been present in their bodies from youngest infancy, while in others it has been a late manifestation, and under these dissimilar conditions one would expect differences in the late results.

The persistent imbibition of considerable quantities of alcohol *combined with* the intake of large quantities of food, especially carbohydrates, is an important element in producing the arthritis with biurate deposits. In poorer patients, beer, the form in which the alcohol is taken, contains a large amount of carbohydrates, while their food also largely consists of bread and vegetables.

It cannot be doubted that any toxæmic process, whether due to what we call septic diseases or to the specific diseases — typhoid, tuberculosis, pneumonia, &c.—all bear upon the question of gout and arthritis in general, what we fail to perceive is just where and how divergence occurs so as to produce the varying types of disease.

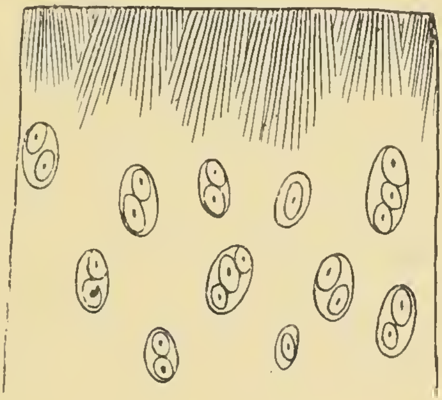

FIG. 20.—A section of cartilage, indicating the deposit of acicular crystals of bi-urate of soda.

It is obvious therefore that the CAUSES of gout are not definite but indefinite chemical processes, which in some unknown way convert the quadriurate of sodium into the biurate, which is only slightly soluble in blood serum, *i.e.*, lymph.

The *deposition* of this biurate of sodium is more intelligible ; it takes place wherever the lymph circulation is slow and rich in sodium, and possibly where cold and exposure are capable of depressing the circulation, and thus accentuating the lymph stasis, or as a result of slight inflammation which increases the viscosity of the lymph and synovium.

The actual deposition of the acicular crystals of biurate, or, as some authorities state, monosodium urate, is a passive one.

From these observations one would naturally conclude that articular cartilage is the ideal place where the deposit would take place, then all forms of connective tissue, wherever situated, whether in and about a joint or forming fascial intermuscular planes. It is known that the biurate may be deposited in the actual synovial fluid, and experimentally it is demonstrable that in indolent, stall-fed animals the synovium is of a more watery character and richer in sodium, therefore more favourable to the formation and deposition of biurate of soda, than in field-fed and active animals. Thus in man equivalent habits may be assumed to effect similar results, and the spread of active outdoor exercise may be a factor in the lessening frequency of gouty joints.

An important point in its pathology is : Does the biurate deposit in *healthy* cartilage and fibrous tissue, or *is it essential* that some preceding damage shall have been done to the tissue, be it demonstrable or only chemical and undemonstrable, before the actual deposit can take place ?

Without going so far as to state that actual coagulation necrosis (or even gross necrosis, as some authorities assert) must exist previous to the deposition, it is only in accord with our pathological knowledge to believe that a gradation of the toxic poisoning occurs by which damage will have been done to the cartilage and fibrous tissue before it is sufficiently virulent or chronic to bring about the change into biurate and its subsequent deposit in the tissues; that is, the usual attack of gout is probably the *climax* to an insidious process, and, as in all other pathology of infective processes, what were formerly called *causes* of gout, as age, sex, emotional excitement, unusual indulgence in good living and injury are only *determining factors* superimposed upon the toxic process.

From the microscopical standpoint all the manifestations of a chronic inflammatory (infective) process are present in the tissues affected by gout; the question remains, is this antecedent or merely *post hoc?* In the mildest or earliest examples of gout the *part of the cartilages* most distant from the underlying bone, also the parts most subject to pressure, are the sites of the deposit, but often the actual free surface is not at first affected. Streaks, patches or minute points of chalk-like appearance develop interstitially; later the free surface is involved and then becomes rough and eroded. The layer of cartilage next the bone, forming about one-third its thickness, rarely becomes affected. Yet when the cartilage is completely eroded, chalky deposits occur in the bone itself.

The subsynovial (subepithelial) areolar tissue, the capsule, ligaments, and the subcutaneous tissue, are all liable to the deposit. When deposits in the subcutaneous tissue are excessive the overlying skin atrophies and finally ruptures, and a discharge of creamy fluid may take place.

If it is a fact that crystals of biurate of soda may form painlessly, one is led to ask whether the deposit is not merely an incident in an arthritis.

Women are said to be protected by the catamenia. After the menopause manifestations of irregular gout are not uncommon in corpulent, plethoric women.

Occupation and Habits.—Absence of exercise and the sedentary occupations, also those in which high living is habitual (butchers, butlers, and indoor servants), also innkeepers and brewers' labourers, plumbers and painters. Yet drunkards are not subject to gout.

Heredity.—It is stated that a family history of gout is obtained in three-fourths of the cases. It is transmissible by the females, who are usually immune. When gout is acquired the diathesis may be transmitted, and in these cases gout is more manifest in the later children than the earlier ones.

Clinical History.

Age.—The disease may occur in young adult life, but usually it takes until middle age to develop real attacks of articular gout—30 to 40, and any time subsequent to this.

Sex.—The male sex is chiefly affected. The tendency to corpulence appears to conduce to gout.

Previous Disease.—Renal disease and lead poisoning loom large in all accounts of gout; the association between the two is very constant. In patients who are suffering an attack of gout the supervention of other acute inflammatory diseases tends to cure or relieve the gout and to some degree protect them from attacks. The relation of gout to previous disease of the joints is undetermined. It may follow osteo-arthritis or precede it. The whole question is too indefinite to more than mention.

The Season.—Winter and early spring generally induce the first evidence of gout, afterwards the attacks may appear in autumn or even the summer.

Inciting causes are trauma, exposure to cold, unusual indulgence in food and alcohol, change of habit and diet. Fits of excitement or other emotions are credited with inducing an attack, but it is highly probable that the emotions are really induced by the depression, dyspepsia, &c., which often result in an attack of gout. Not infrequently there is no exciting cause, the attack is the climax of an insidious process.

Articular gout may be—

(1) Acute.

(2) Chronic.

The acute form affects most commonly the most distant joints first, therefore the metatarso-phalangeal articulations and foot, the ankle, and knee—so following the centripetal law. The hands and small joints of the wrists then become involved, and the elbows occasionally. Then any other joint, but the shoulder and hip are infrequently involved.

The *Onset.*—In a first attack *premonitory symptoms* are overlooked; later, experience teaches the patient to observe them, or they may be absent. They invariably consist of some *gastro-intestinal disturbance* (which I regard as exacerbations), dyspepsia, constipation, and offensive stools, flatulence, heartburn, anorexia, palpitation; also mental depression or headaches, and premonitory symptoms peculiar to each patient—nervousness, irritability, cramps. Occasionally, however, when the patient feels unusually fit (and dines,

&c., accordingly) he succumbs to an attack. Uneasy feelings or twinges of pain in the joint may precede the actual attack.

During this period a brisk purgative, light diet, abstinence from alcohol, and a certain amount of exercise may abort the attack. Otherwise a *sudden attack of severe* pain takes place. Not infrequently in the small hours of the morning the patient is awakened by the pain, and may experience a sense of chill or a slight shivering fit.

Fever.—The usual signs of fever are present. If the *temperature* is taken it is generally raised to 99° or 100°, later it rises and may reach 101° or higher in severe attacks; when the temperature attains high degrees, 104° or 105,° there is usually considerable toxic poisoning complicating the attack, as evidenced by vomiting or diarrhœa. The pain increases rapidly till it becomes excruciating, and in five or six hours may slightly lull, *i.e.*, towards the later part of the day; especially is this the case if sweating is induced.

As in any other form of really acute joint pain, the dread of a "jar" to the part excites considerable apprehension of all vibration, and especially any movement of the bed.

EXAMINATION OF THE JOINT.—Perhaps no other inflammatory joint affection more resembles an acute suppurative arthritis than gout.

Swelling.—The joint landmarks are obscured by an ill-defined swelling, at first of moderate dimensions but later, *i.e.*, the next day or two, increasing to a considerable extent and degree. The *skin* is red, tense, shiny, of a mottled or livid blue, it looks as if about to burst. The veins may be distended. There is exquisite *tenderness,* and the hyperæsthesia is even greater than over an abscess or very acute arthritis, which are the only conditions it is liable to be mistaken for.

Œdema is a constant sign and can always be elicited by pressure with the finger-nail. After twenty-four or forty-eight hours definite pitting may be obtained (if the pressure is tolerated).

Movements.—Limitation of movement is absolute. There is no spasm of muscles when the small joints are affected, but it is present in the case of the large joints.

Besides the signs of fever there are no unusual general symptoms. The *urine* is scanty and high coloured, and often deposits urates. Previous to an attack it has long been held that the amount of uric acid excreted was less than the normal quantity, but more recent investigations have contradicted this. Similarly during an attack and soon after, the quantity was said to be greater than the normal, but there is no absolute regularity in the relation of the attacks with the amount of uric acid excreted. Albuminuria is equally inconstant; if present to a definite amount it indicates renal disease.

The Course of the Disease.—During the day some amelioration may occur, but for two or three nights (or even longer) the pain recurs with great violence. Then the treatment begins to take effect and the general level of pain is lower, but the local condition persists and may even be worse in appearance, then gradually subside after some seven days or so.

An attack lasts ten to twelve days or longer, and may even become chronic. During the stage of subsidence the signs of inflammation gradually subside, but some blueness of the skin may persist for a little time after, and desquamation is frequent. Occasionally intolerable itching occurs. Complete recovery with absorption of the biurate is said to occur.

Sequelæ.—Suppuration never occurs, but stiffness persists for a considerable time in many cases, and after repeated attacks ankylosis occurs, and marked distortion from deposits of large quantities of sodium biurate in the periosteal attachments. Subluxations occur.

Chronic Gout.

It is chronic gout which is so difficult to differentiate from subacute infective arthritis and osteo-arthritis. When an acute attack becomes chronic, from absence of treatment or neglect on the part of the patient, the history enables one to form a clearer opinion, otherwise the signs and symptoms may so closely simulate one another that only the result of treatment suitable to each disease and the aid of X-rays will enable one to diagnose the lesion correctly. Ironside Bruce and others have called attention to the presence (X-ray) of small bony or calcified nodules at the periphery of the joint margins, probably developed in the ligaments and fibrous tissue of the capsule and of the periosteum of the shafts, also of small abscess-like cavities in the articular extremities, as if small portions of the bone had been scooped out.

These, however, are *common* to gout and septic arthritis, and there are *no* absolutely pathognomonic X-ray appearances of gout.

The rarefied areas contain a clear, gelatinous, viscid material.

If the disease *begins in a chronic or subacute* manner, it usually affects several joints, is less violent, but more prolonged. The evidence of arthritis common to all chronic affections occurs: Fluid, thickened synovial membrane, over-growth of cartilage or deposits of biurate simulating such, creaking and rough movements, are felt.

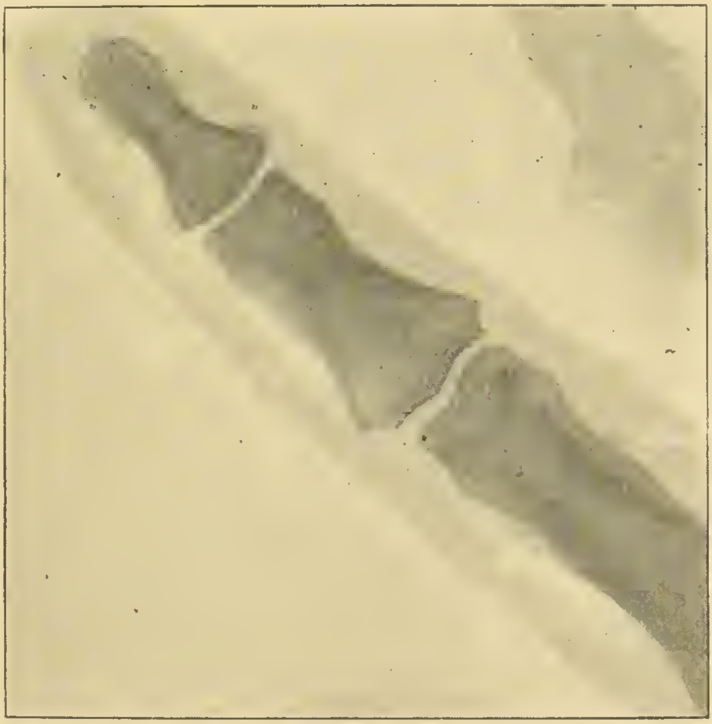

FIG. 21.—Shows the peculiar bony additions called Bruce's nodes, which arise not only in the immediate vicinity of joints, but also on the shafts of the phalanges. They are, in my opinion, analogous to spondylitis deformans.

The following gives in a tabular form the main distinctions between osteo-arthritis and gout:—

	OSTEO-ARTHRITIS IN GENERAL	GOUT
Sex	Females—really a doubtful statement in my opinion	Males.
Social condition and habits	Poor ; ill-nourished	Well-to-do, over indulgent, or of the sedentary type ; deficient exercise
Onset ...	Usually insidious ; a minority acute	Acute, and generally at night
Number of joints	One joint severely, but associated with similar, less marked conditions in others, often symmetrical	Usually in one joint, it may afterwards attack others, but invariably sticks to one
Pain ...	Much less violent ; more aching, gnawing ; worse in mornings and after rest	Severe ; may be excruciating ; worse at night ; relieved by rest
Referred pains	Neuritic pains common	Nil
Swelling ...	None, slight, or moderate ..	Always marked, and with much peri-articular involvement
Signs of inflammation	Slight	Marked
Sites ...	Frequent in knee, shoulder, hip, vertebræ, and temporo-maxillary joint	Rare in these ; the distant joints chiefly affected
General disturbance	Slight	Marked
Other signs		Tophi
Attacks ...		Some degree of periodicity
Cause ...	Closely associated with injury, exposure, &c.	May be quite inexplicable
Heredity ...		Very strong, it is said

Treatment.—*During an attack of gout* in a vigorous person the general treatment should be directed to the relief of the symptoms and the gouty condition.

The patient should be confined to bed, and a brisk mercurial purgative followed by sulphate of magnesium should be given; then the bowel is kept acting regularly, but not violently, and sodium salts should be avoided.

The *diet* should consist of liquids at first, a period of twenty-four hours' starvation being probably most useful. Milk, with citrate of potash ʒi. to Oi., is the most suitable form of nourishment and copious drinks of water should be taken. Later, milk puddings, bread, and fish are given, then white meats.

Alcohol is best entirely interdicted. All forms of meat, meat juices and broths are forbidden (personally I do not entertain this dread of meats), and salt must be eliminated from the diet.

If the patient is debilitated and the attack recurrent, then a more nourishing diet should be given, and if he is accustomed to drink alcohol a small amount of whisky or brandy may be given. At night nepenthe or some form of opium should be given to secure sleep.

The specific treatment consists in administering vini vel tinct. colchici ♏xx to ♏xxx three times daily. It is wise to give a little stimulant (whisky or brandy) with the colchicum, as it has a depressing influence on the heart and the spirits of the patient. When the disease is subsiding the salicylate of lithium or quinine and iodide of potash are indicated and should be given in full doses with suitable precautions, followed by tonics and stomachics. A return to ordinary diet must be made gradually.

In my opinion the most important proceeding is to discover and eliminate all septic foci, and this should be done as soon as the acutest phase subsides, unless the condition requires only medicinal measures. If foul gums and septic stumps exist they should be cleaned frequently during the acute stage, but the teeth not then extracted, as thereby a certain amount of trauma with *increased dose of poison* results and may produce an exacerbation of the gout at the time.

The Local Treatment.—I have found a Bier's bandage applied to the thigh or arm of the utmost value. Whether it appears consistent with our views on the pathology of gout or not, the practical effect is unquestionably good.

The part should be lightly covered with warm flannels when the bandage is in use, and during the interval when it is not applied the wool compression flannel bandage can be applied. It requires the utmost gentleness, but quite a degree of compression can be obtained. It cannot be applied previous to the use of a Bier's bandage, as it will not be tolerated. If a Bier's is not used the part must be warmly swathed in dry cotton wool or flannel and covered by an impervious material, then slightly elevated. Gentle perspiration always tends to relieve the pain. Bathing with strong soda solution and poppyhead fomentations are not as useful as the constant dry heat. Mesotan, Bengué's application (methyl-salicylates), and salicin ointment smeared over the area relieves the pain to a slight degree. Above all avoid cold. Despite the indications it is stated that depletion by leeches is harmful. As the process subsides, massage and movements are carried out, and should the condition tend to become chronic—after ten to fourteen days with a

Bier's treatment—counter irritants of a mild nature, capsicum plaster, mustard foot baths, liniments, and strong salicin ointments should be used. The hot-air douche or baths assist resolution when recovery hangs fire. During the intervals appropriate treatment and a suitable dietary and mode of living must be instituted ; above all removal of all septic foci and functional irregularities, especially constipation.

The subject of purins is still *sub judice.* Many misconceptions are held on the relationship of purins to gout; but so conflicting are the isolated facts brought to light by individual investigators regarding the foods which contain purins that, for the time being, it is wise to employ a dietary suggested by the results of experience, and ignore the ultra-scientific laboratory work. Since it is stated that the "white meats" are as strongly purin-containers as "red meats," one must be prepared to entirely ignore purins altogether for the present.

OSTEO-ARTHRITIS.

It is my intention to discuss, under the title of Osteo-arthritis, a variety of changes in joints, which, in the past, has created endless confusion, and, consequently, a nomenclature of formidable dimensions.

It comprises a group of symptoms of different degrees and varying proportions which may be acute in onset or arise in an insidious manner. When once established the condition has hitherto been progressive and eventually crippling in its effect. But as the origin of the trouble was entirely overlooked, and only local measures directed to the relief of the symptoms were practised systematically, one cannot be surprised at the failure to check the disease. Furthermore, the local treatment was based on wrong principles, the chief of which was rest and strict avoidance of active and passive movements. This resulted in ankylosis of some variety, and this condition once developed added an *additional type of symptoms*, and further complicated treatment, so that all degrees and varieties of signs and symptoms arose, leading to confusion and complexity ; and what one practitioner would call chronic synovitis others would call chronic rheumatism, rheumatoid arthritis, chronic arthriticism, osteo-arthritis, and so on.

From experience of a very large number of these cases I believe they all are due to one cause—toxæmia—modified, as in every other disease, by the conditions which are due to individualism, also by environment, slight injury and previous affections in the joint, occupation, and what is called selective affinity of the bacteria or their toxins, but above all by the *situation and exciting cause of the toxic process.*

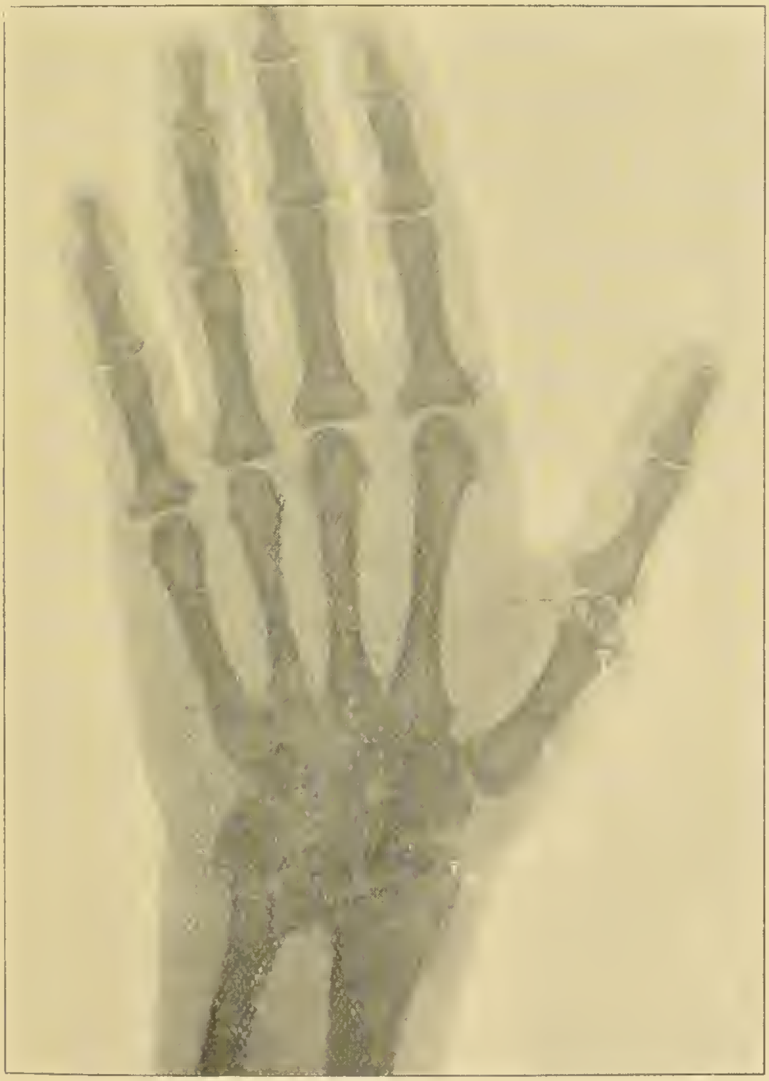

FIG. 22.—The arrows point to the peculiar rarefied pseudo-abscess-like areas in the bone extremities found in osteo, rheumatoid arthritis, and gout (see fig. 31.)

Age and sex appear to exercise no *specific* influence.

I find this affection in youth and early middle life, equally frequently in males and females.

Predisposition.—Certain joints are more frequently involved than others, but every joint in the body, including the vertebral articulations, are quite commonly affected, so that no real predisposition exists other than that created by the influence of overwork, or the superficial character and badly protected nature of certain joints, and by occupation, &c.

It must be remembered also that one and the same underlying cause may produce disease in joints of very different *clinical* aspects, so that in such an affection as gonorrhœa we may find a range of symptoms in a joint, the *mildest* of which may be a transient synovitis and the *severest* a suppurating arthritis, or the other extreme, a chronic fibrous synovitis or arthritis. So, in cases in which there are foci of infection or suppuration in the body, a joint may show the same range of symptoms :—An acute, rapidly developing synovitis or arthritis, a mild or subacute lesion, a suppurating joint or a chronic inflammatory affection, which is, indeed, the disease we now call osteo-arthritis and rheumatoid arthritis.

The Pathological Condition.—In the most insidious or mild and chronic varieties, owing in a large measure to the slight prominence of those changes in the vessels and tissues usually associated with acute inflammation, doubt is expressed that the joint changes called osteo-arthritis are of an inflammatory nature, and as these same obscure and "degenerative" changes are observed in the joints described as neuropathic, Charcot's, &c., obscure nervous pathological conditions have been assumed to be also the underlying cause of these osteo-arthritic diseases. There is, however, ample clinical evidence to show that the explanation of these low forms of inflammation is simply a matter of degree, as the typical forms are due probably to *prolonged* toxæmia of a *mild* type, in which the vascular reactions are of the slightest, while the tissue changes in the form of degeneration or hypertrophy are marked. Acute examples occur in which the vascular inflammatory phenomena are prominent.

If any form of bacterial activity is proceeding as a local inflammation anywhere, the chemical products of the bacterial action—toxins—are absorbed into the lymph and, finally, into the blood circulation. Here they may be destroyed or rendered inert by the blood plasma. If the quantity of the toxin is too large to be dealt with by the plasma, its presence in the blood-stream (and its re-diffusion into the lymph) circulating in the liver, spleen, and bone marrow, stimulates the formation of protective or neutralizing bodies therein; thus again, in this way the toxins may be rendered inert, *always however at a price*—namely, GRADUAL DETERIORATION IN THESE ORGANS. During the time the toxins remain in the circulation, however, they tend to damage all the tissues they bathe—the amount of damage being relative to the intensity and concentration of the toxins, as seen in acute inflammations, they may produce instant death of cells; but in the mildest toxic processes no demonstrable damage is effected, *unless* the process is very prolonged, *i.e.*, chronic, in which case changes occur in the cells of the body of a degenerative nature—a slow destructive process. During such a chronic toxæmia periods of exacerbation occur in the local focus, and if sufficiently intense, real inflammatory attacks may be set up by the circulatory toxins in any distant portion of the body where there is insufficient resistance, or where any aid in the form of slight injuries, exposure to cold, excessive use, and suchlike is afforded the toxic process.

It is this combination of chronic toxæmia, with repeated exacerbations, which is the cause of OSTEO- AND RHEUMATOID ARTHRITIS. It is practically certain that in all septic or infective processes a constant stream of bacteria (as well as their toxins) is discharged into the blood-stream, however few they may be in these *chronic* local processes. It is demonstrable that from time to time the bacteria themselves, in few numbers, reach the joints and produce definite inflammations with exacerbation in the symptoms.

Recent investigation has shown that the bone marrow and muscles play an important part in the formation of antibodies, and as the bones have a very well marked blood supply they are subject to large doses of toxins, and, as we would anticipate, during exacerbations of any toxic process they (the bones) undergo a mild inflammatory process, especially at their cancellous extremities, which ultimately becomes a rarefying osteitis; this especially occurs in the cancellous bone subjacent to the junction of periosteum, capsules, and synovial membrane, but does involve the whole of the bone extremity.

Consequently, the *periosteum* covering the bone at this point is, like the synovial membrane, hyperæmic, and so tends to deposit bone and to result in proliferation of the cartilage—lipping; yet this is not an invariable concomitant of arthritis or bone lesions, as may readily be observed in any museum containing examples of tuberculous disease. It may be said

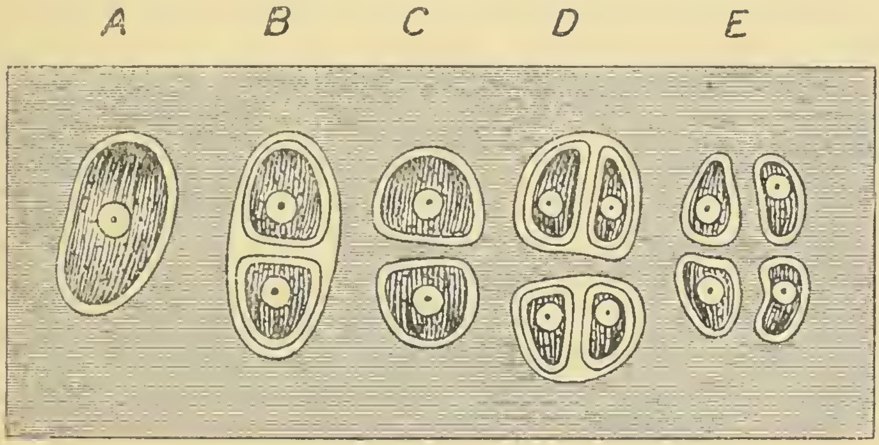

FIG. 23.—From Schäfer. Shows how the normal cartilage cells enlarge and undergo cell division, and the formation of the matrix from their capsules.

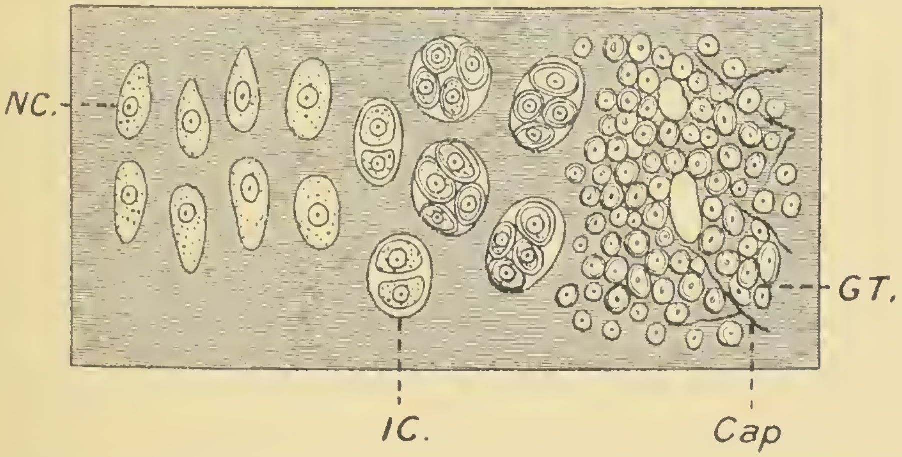

FIG. 24.—Cartilage cells proliferating, the capsules burst, granulation tissue extends into the pits so formed. *GT*, granulation tissue; *Cap*, capillary; *NC*, normal cell: *IC*, inflamed area cell.

consequently that toxins *vary in their effects* according to their nature, virulence, and concentration, and upon this depend the different clinical and pathological *manifestations* of identical infections.

THE ARTICULAR CARTILAGES.—As a result of the rarefying osteitis and the action of the toxins circulating in the lymph in the cartilages and synovium, the cartilage cells either die instantly or gradually atrophy, *i.e.*, degenerate, or they proliferate, burst their capsules, and undergo disintegration, and the cartilage becomes thinned or fibrillated and softened, it is thus easily rubbed away in the movements of the joint, and especially therefore at the central portions.

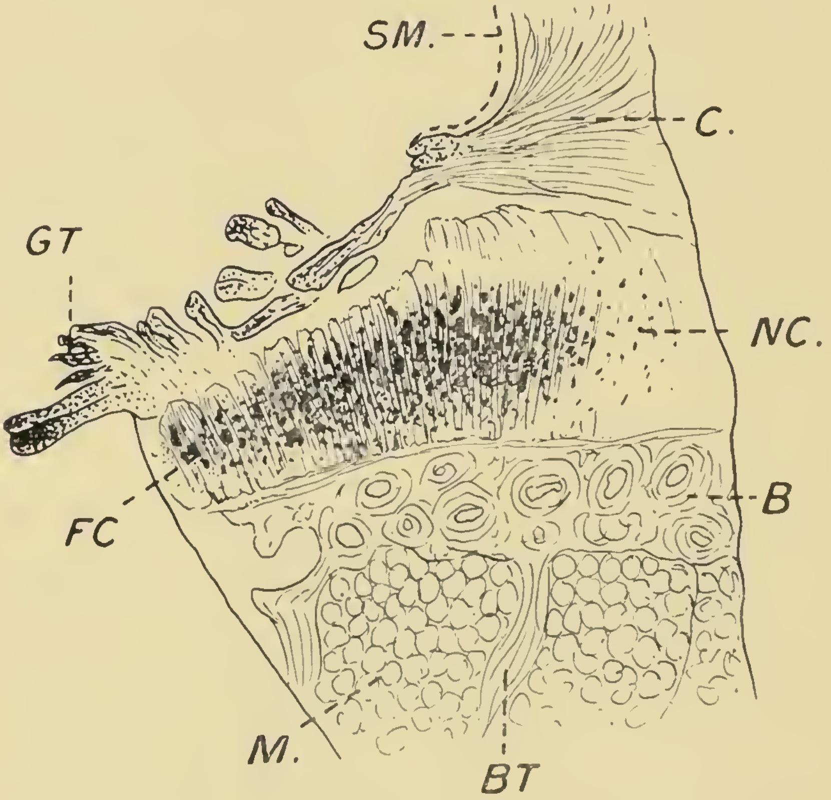

FIG. 25.—*Fibrillation of cartilage.* *C*, capsule; *SM*, synovial membrane; *GT*, granulation tissue; *FC*, fibrillated cartilage; *NC*, normal cartilage; *B*, bone; *BT*, bone trabeculæ; *M*, marrow. (Microphoto. after Keen).

Under the influence of chronic inflammation the matrix of articulated cartilage readily tends to revert to its primary fibrillated condition.

In the periphery of the cartilage the cells likewise proliferate and if the blood and lymph supply is abundant *these* daughter-cells survive and result in hypertrophy — hyperostosis ; if however, for any reason, conditions are unfavourable, they die, and gradual atrophy (*i.e.*, degeneration), results. Sometimes the proliferated cartilage cells become converted into fibro-cartilage or even fibroid tissue of a low form.

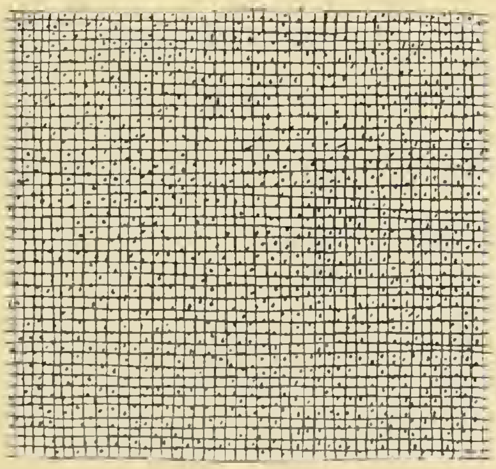

FIG. 26.—The matrix of normal articular cartilage after treatment with trypsin. (After Tillmann).

In either case friction may produce erosion and thinning, and finally exposure of the underlying bone. *So one finds in the same specimen both atrophy and hypertrophy associated.*

THE SYNOVIAL MEMBRANE.—As a rule this is so well supplied with blood that in general the circulating toxin serves not to destroy the synovial endothelium, but to excite a hyperæmia, *which is always productive of new growth*, hence we find a tendency to proliferation and thickening, *i.e.*, FIBROSIS, the villi become enlarged, the endothelium thickens, any residual cartilage cells existing in the villi are excited to growth, and *cartilage bodies develop.* Especially does this occur at the points of reflection on to the bone, where it unites with the periosteum, and where hypertrophy of cartilage and bone almost always takes place—the *lipping* of osteo-arthritis. This is not an invariable sequence, as many osteo-arthritic joints do not show lipping but undergo atrophy, while one joint will be a typical osteo-arthritic joint and another in the same patient show the peculiarly marked changes described under Rheumatoid Arthritis.

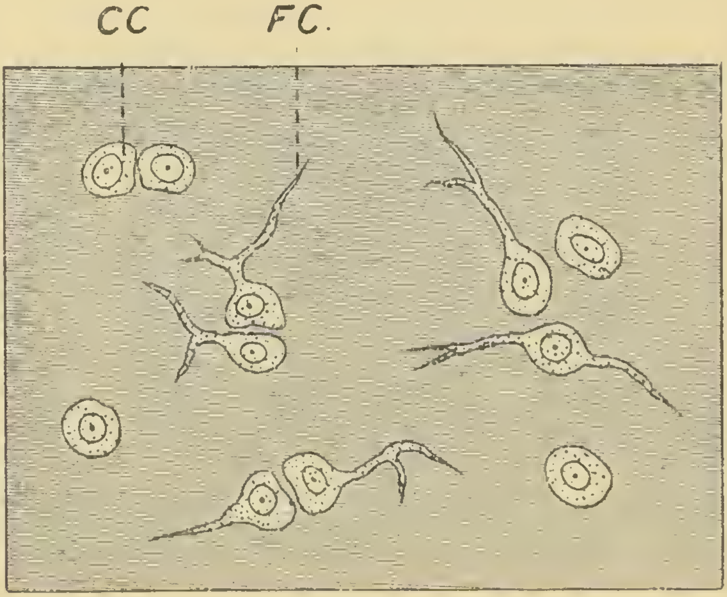

FIG. 27.—Shows the normal transition between articular cartilage and synovial membrane. *CC*, normal cartilage cells; *FC*, cells becoming fibrous tissue. (After Schäfer.)

THE CAPSULES AND LIGAMENTS thicken and contract, and if a joint is kept *at rest in a flexed position, it may be permanently fixed there,* partly by the contraction of the soft structures and partly by the inequalities produced by the hypertrophied cartilage, which acts mechanically by locking the joint or causing pain on movement.

Not infrequently calcification of the capsule and ligaments takes place. The more fixed the joint by rest the denser the fibrous thickening, as it becomes more contracted and consolidated.

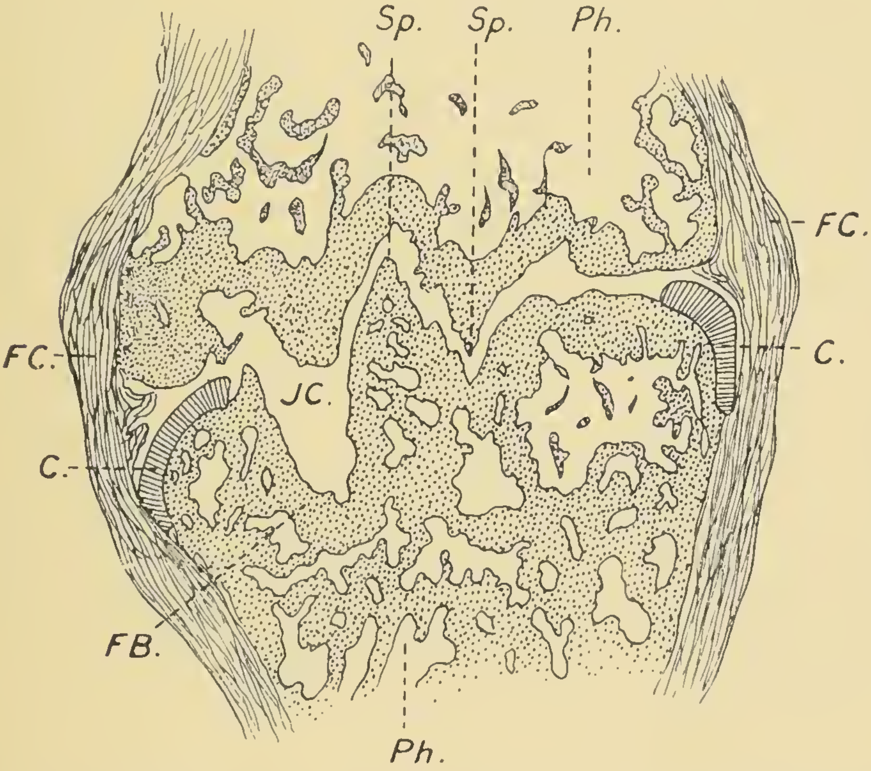

Fig. 28.—Eburnation of bone and formation of spiculæ and hyperostoses. *JC*, joint cavity; *C*, remains of cartilage; *FC*, fibrous capsule: *Ph*, rarefied bone; *FB*, the dense layer of bone-eburnation; *Sp*, spiculæ. (Microphoto. after Keen.)

Eburnation.—One of the most striking *late* changes in a typical osteo-arthritic joint is the complete disappearance of the cartilage and the conversion of the exposed bone into a superficial dense layer which is usually scored by ridges or lines.

This *eburnation* is difficult to entirely account for, except that it must be due to the hyperæmia setting up a sclerosis immediately under the cartilage before the latter is rubbed away.

Varieties.—Osteo-arthritis appears under two anatomical conditions:—

(1) A *poly-articular* variety usually more acute in its onset, in younger patients, and having a special predilection for the smaller joints. This form of the disease is considered to be different from the second variety and to constitute a definite entity—rheumatoid arthritis. (See p. 137.)

(2) (*a*) *A less widely diffused variety.* In older subjects, generally MARKED in one or two joints, but its presence will invariably be found in other joints if carefully sought for. In these cases it is highly probable the worst joints were the seat of injury or may have been diseased in youth, or in some other way damaged and predisposed.

(*b*) A sub-variety is described, the *mon-articular*, in which generally one hip (or other large joint) is involved to a grave extent; but, as has just been stated, careful examination elicits milder involvement of other joints.

The hip is so often involved in this variety, in men, that it is more than probable trauma enters largely into the pathology of the condition.

In *infancy* the condition is known as Still's disease; it occurs during the first few years, before the second dentition, and may go on to suppuration.

Still himself believes these cases are always associated with, if not due to, inherited syphilis (see p. 164).

In my opinion the classification is purely arbitrary; the commonest mode in which it is seen by me is intermediary—*i.e.*, two or more, usually symmetrical, joints are generally involved in a fairly acute or more advanced degree, or first one joint, then another one; at other times a general involvement of joints may occur, but some are more acutely diseased than others.

Heberden's Nodes.—The peculiarity of this form of osteo-arthritis consists simply in its affecting the terminal phalanges of the fingers, and in no other particular does it need special mention.

In spite of its unsightliness it appears to produce very little real interference with the function of the fingers. Its regular arrangement and its more insidious mode of onset differentiate it from gout.

That the condition may arise with a considerable degree of rapidity in some cases and with premonitory vascular and nervous symptoms resembling those commonly associated with rheumatoid arthritis, I can vouch for, and so again substantiates my experience that grades of the joint conditions occur, linking the extreme varieties of osteo and rheumatoid arthritis.

Signs and Symptoms of Osteo-arthritis.

I here give the conditions found in patients who represent the other extreme to that described as rheumatoid arthritis. Thus between the two descriptions a faithful guide should be found to these very common affections.

Frequently a large joint will show typical osteo-arthritis, and a small joint a typical rheumatoid arthritis; or a joint diagnosed as rheumatoid will eventually become a typical osteo-arthritis.

Women invariably are the subjects of these perplexing varieties, and this, I think, is associated with *hidden genital sepsis.*

In young boys and adolescents, as well as girls, preceding symptoms of a quasi-Raynaud type of vascular disturbance is seen, and I have had a case of this nature who developed hæmoglobinuria.

The frequency with which osteo-arthritis is found in growing girls and boys affecting the foot joints, is very great, and is the usual preliminary to hallux valgus and flat foot.

Generally the onset is acute, often following trauma, such as a fall or strain, some unusual mode of exercise, or cold and exposure. *Premonitory* neuralgias, shooting pains, discomfort in the joint may precede the actual onset in some cases.

The *revealing* causes, as these may be called, are usually quite insufficient to set up disease—even a mild synovitis—in a person free from a septic process, and it must be recognized that they are merely contributory.

In the case of more severe traumatism, such as a sprain or synovitis which does not clear up, it is highly probable osteo-arthritis sets in at the same time, and is the *cause of the prolonged attack.*

On the other hand, the condition may begin in a most insidious manner, gradually getting worse, and leading to some of the severest examples of the affection.

Pain is the commonest symptom, it may be the only symptom throughout an attack; it is, therefore, constant. It varies greatly in degree, from a sense of aching—constant, dull, gnawing, or boring—to acute pain.

It is invariably worse in cold, damp weather, or during exposure, and when the general health is depressed; also after long rest, and therefore is often worse on getting up in the morning when the first few movements may be very painful, or there is added a sense of extreme stiffness. After getting about for some time, this extreme pain gives way to a duller type, and in milder cases is almost lost during the day, to return at night when the patient is fatigued, or takes rest indoors in a warm room. In spite of cold and exposure generally aggravating the disease, many patients complain that the pain is much worse when they get warm in bed; these often find relief by cooling the joint by exposing it to the air.

Quite frequently patients are badly, though temporarily crippled, and limp with pain.

A large number of patients do not have—

Swelling.—I teach that "if there is very little to see, but the patient feels a great deal," it is generally an osteo-arthritis. The majority have slight swelling; others have considerable synovitis; a lesser number have a pronounced hydarthrosis.

If swelling be present it may consist of fluid without much thickening of synovial membrane, or of much thickening and little fluid. Occasionally the thickening of the synovial membrane is very marked in the knee-joints, and soft masses of hypertrophied villi can be made out in the cavity. This is generally found in the late stage, after the acuter forms of the disease.

If due to fluid, generally the swelling assumes the shape of the synovial membrane; often it also fills communicating bursæ, while in the large effusions it displaces and compresses adjacent structures, and may produce local bulgings beyond the area of the joint.

It is the commonest cause of Baker's cysts (hernial protrusions of the synovial membrane). The latter will persist after the arthritis has improved and the effusion disappeared if their communication with the joint is cut off by fibrous adhesions, as is usually the case after a certain length of time.

Ganglia on the dorsum of the wrist are invariably due to localized osteo-arthritis of the joint or teno-synovitis.

Redness is not generally observed unless there is a marked accompanying synovitis, or, as is not infrequent, an overlying bursa may be acutely inflamed.

Posture.—Unless there is definite ankylosis due to previous attacks, or a great effusion exists, the posture is rarely such as to be of value. The cases with little or no swelling are able to fully extend the joint, but only with reluctance—partly on account of the stiffness felt, and partly because all movements may be very painful ; the movements are consequently carefully and slowly carried out. If there is effusion a flexed attitude is assumed.

Deformity is not infrequently observed even in the bigger joints ; while in the smaller digital articulations it is frequent as nodosities and partial (pathological) displacement. The thumb is most frequently affected and the distal phalanges of the fingers. Definite ridges or bosses may be seen and felt in the subcutaneous joints. On the contrary, no abnormality may exist.

Ulnar deviation, hallux valgus and rigidus, flat foot, and other typical conditions are invariably found associated with osteo-arthritis.

As with redness, so

Heat and Œdema are usually absent. In acute cases with much synovitis, heat and œdema both exist, more especially in the cases which affect the proximal interphalangeal articulations and the small joints at either extremity of the clavicle, and the temporo-maxillary articulation.

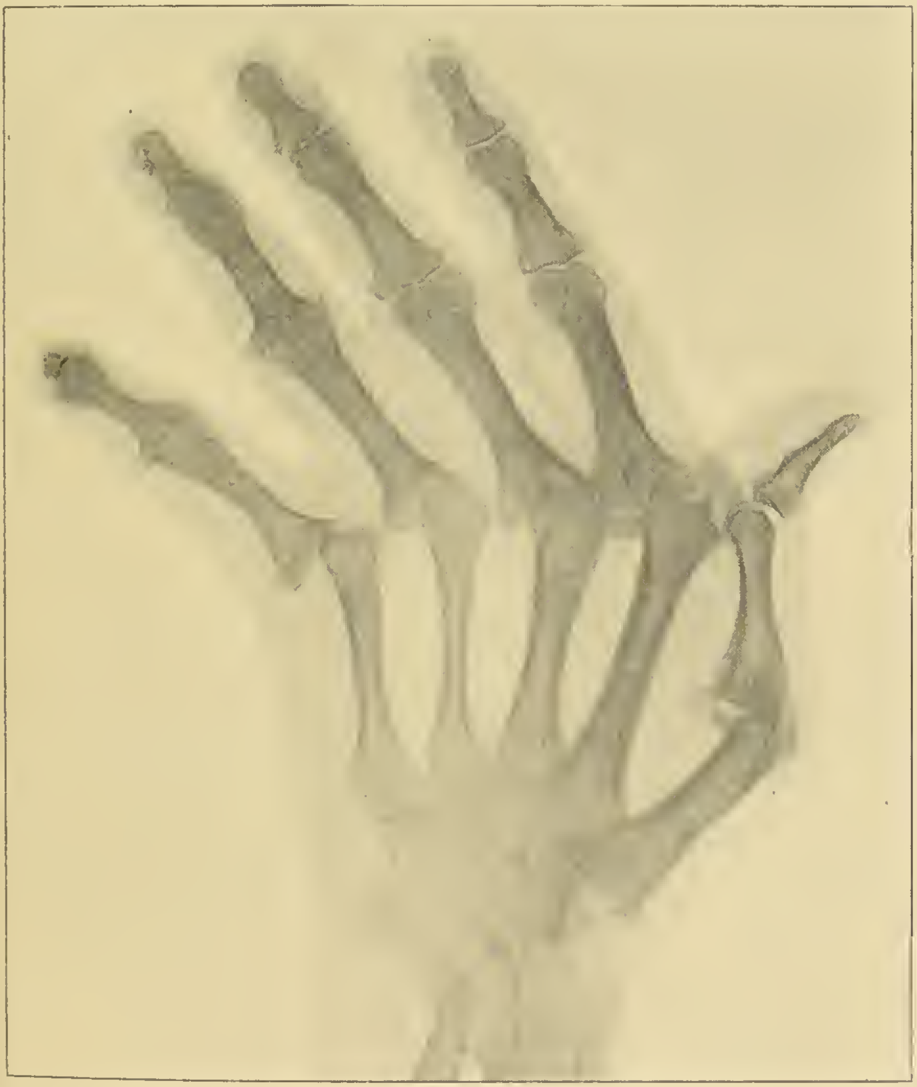

FIG. 29.—Shows the ulnar subluxation, *i.e.*, pathological displacement, associated with osteo-arthritis; this is strictly analogous to hallux valgus.

Fluctuation depends upon the absence or presence of fluid; it may be detected if carefully sought for in the subcutaneous joints in three-fourths of the cases. Thickening of the synovial membrane, chronic œdema of subligamenous pads of fat in the knee, effusion into adjacent tendons (ankle especially), or into bursæ, may mislead one in cases in which the joint is dry, or, at most, contains very little fluid. Many joints and bursæ which give a sense of fluctuation may contain in reality very little fluid, the chief swelling consisting of the thickened œdematous synovial membrane.

Active movements, as before stated, in the chronic phases may be of full range, but are usually sluggishly carried out; considerable mental and muscular effort may be needed to perform them.

In other cases quite free movements may be performed within a definite range, but beyond this range patients refuse to flex or extend the joint, as pain immediately results, although by gentle passive efforts these degrees may be exceeded.

In the acutest cases, active and passive movements may be so painful that they are not possible; these are the cases which tend to ankylosis and deformity, as the patients keep the joints at rest in a flexed position. *Passive movements* are invariably less painful than active; the range of movement depends upon the pathological condition, and freedom or absence of pain.

During these movements, especially BRISKLY performed active efforts, the sensation called CREPITUS is felt in 80 per cent. of cases. The palm of the hand, and *especially the first* (proximal) phalanges, are most sensitive to this. It may be coarse or fine; personally I cannot say that much value is attached to this distinction, nor can I say whether one is synovial or cartilaginous, the other bony. It is simply an evidence of roughness of the articular structures. In mild cases it should be listened for with the stethoscope.

The condition called *lipping*, and the more massive bony changes found in the ball and socket joints, can be detected in a large number of cases; increase in the size of the bony extremities, distortion of their shape, or roughness in the outline, is characteristic of the disease.

The presence of synovial fringes and cartilage bodies is rarely palpable to the fingers; occasionally, however, the latter are distinctly felt, and may be fixed or slightly movable.

The **muscles** are generally more flaccid than in other joint conditions, unless pain is marked, then there is spasm.

The wasting of the muscles associated with arthritis exists, and in bad cases of osteo-arthritis this may be extreme, but if properly treated great wasting *is quite the exception*. As one expects, the condition of the muscles depends upon the acuteness or chronicity, and the exact pathological conditions present, and especially on the presence or absence of ankylosis.

Never omit to examine the other joints of the body for signs of quiescent arthritis, especially creakings, snappings, &c., on vigorous movement; they will be found to exist in the greater number of these patients.

If a specific cause for a *referred pain or neuritis* in any patient cannot be discovered, look for osteo-arthritic changes in the joints or spinal column. A great deal of occipital headache is due to osteo-arthritis, *i.e.*, spondylitis deformans of the cervical vertebræ.

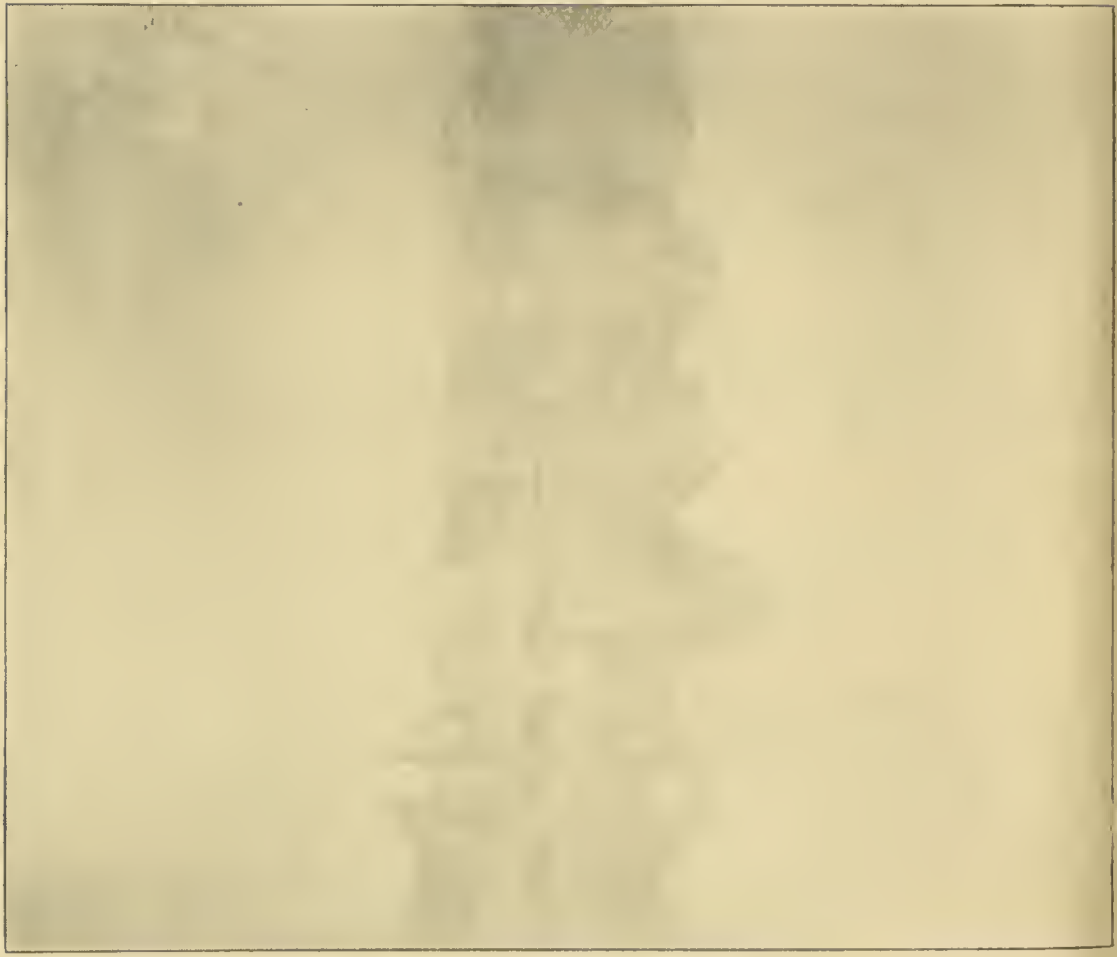

FIG. 30.—An example of spondylitis deformans in which calcification or imperfect ossification takes place in the fasciæ and ligaments connected with the vertebrae and the intervertebral discs. My belief is that Bruce's nodes and the changes in spondylitis are identical.

The **general condition** varies from no obvious departure from the normal to a severe degree of ill-health. In a moderate case there is some fever ½° to 1°, and general disturbance due to the pain, loss of sleep and exercise. In the insidious cases, if the temperature is taken carefully, slight pyrexia is found. Acute cases exhibit fever, even reaching 101° F., or higher. If many joints are involved, or the process is acute, the condition simulates sub-acute rheumatism or other septic fever, and the diagnosis may be difficult.

I consider the general condition varies a great deal according to the nature of the primary septic focus. If there has been prolonged septic intoxication, and especially if the gastro-intestinal tract has been the seat of a prolonged infection, or the genito-urinary system is gravely damaged, naturally the general signs and condition of the patient will be worse than if the cause of the osteo-arthritis was some fleeting infection. One must remember that the arthritis is but a part of a general toxæmia.

Treatment.—I wish to emphasize my implicit belief in the truth of the pathogeny of osteo-arthritis as herein outlined, by stating that the important element in treatment is *not* the local treatment, but the discovery of the underlying chronic septic process and ITS CURE. If it is impossible to cure, then it must be ameliorated as much as possible, and its ill-effects warded off.

The local treatment in mild cases may be ignored even, while in more severe cases *as long as fixation of the joint either by splints, apparatus, or absolute rest in bed* is avoided, and the patient performs active movements daily, amelioration and possibly cure of the *acute* attacks will take place as a matter of course. I do not mean to ignore or belittle the value of local treatment, but no amount of local treatment will avail to ward off exacerbations or recurring attacks if the associated septic infection is ignored or overlooked; the one is curative, the other palliative. Cure of an established osteo-arthritis is always imperfect. Seventy per cent. of all my joint cases had an associated lesion in the gastro-intestinal tract, 10 per cent. in the genito-urinary tract.[1]

Among the 70 per cent. were many cases of mixed infection, *i.e.*, genito-urinary, thoracic and respiratory, and cases with ulcers, glands, &c., as well, but I consider the main lesion in these was the gastro-intestinal sepsis, as proved by the result of correcting this alone. The *gastro-intestinal sepsis*, wherever situated, was *always initiated by oral sepsis.*

Unfortunately, there is, even amongst dentists, wide divergence in the standard of oral cleanliness; many will pass a mouth in which obvious inflammation of the gums (*gingivitis*) exists, especially if this is around stumps bearing crowns, or a tooth employed in supporting dentures; while others consider tartar quite innocuous, whereas probably it is one of the commonest causes of gingivitis. Bridges are abominations.

Gold crowns also are prolific sources of gingivitis, while a very dangerous custom still persists of not removing all stumps previous to the wearing of artificial teeth. Carious teeth, alveolar abscess or sinus, and suppurative affections of the salivary glands and the nasal accessory chambers, are amongst the common causes of osteo-arthritis.

Uncured urethritis and urinary sepsis of all kinds is commonly the starting point of osteo-arthritis;

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[1] *Brit. Med. Journ.*, January 15, 1910.

while thoracic affections, in which there is catarrh or suppuration in the bronchi or infected glands, may start and maintain joint affections. In brief, no focus is too small to be ignored.

The importance of leucorrhœa in women is very great, and whether it is or is not gonorrhœal is quite immaterial; its treatment by permanganate and other astringent douches is imperative. Endometritis, &c., must be cured if possible.

The influence of pregnancy, and especially any puerperal infection, upon a rheumatoid or osteo-arthritic patient may be very pronounced.

To *repeat*, hidden or ignored sepsis is THE cause of osteo-arthritis.

Rheumatoid Arthritis.

This is stated to be a type of arthritis which is more acute and has other characteristics than those of the *typical* acute osteo-arthritis, and certain authorities consider it is a different disease, which therefore they name "rheumatoid arthritis." As it is but right to give this subject every consideration, in view of its importance, in spite of my belief that it is but a phase of the infective processes which produce typical osteo-arthritis, I have abridged the articles on this subject by Dr. Garrod in Allbutt's "System," and incorporated the views of other writers which support the claim to call this form of arthritis an entity (?). I also criticize the value of some of the statements.

The whole subject is fully discussed by Dr. R. Llewellyn Jones in his book on "Arthritis Deformans." The effect of reading this work is to leave upon my

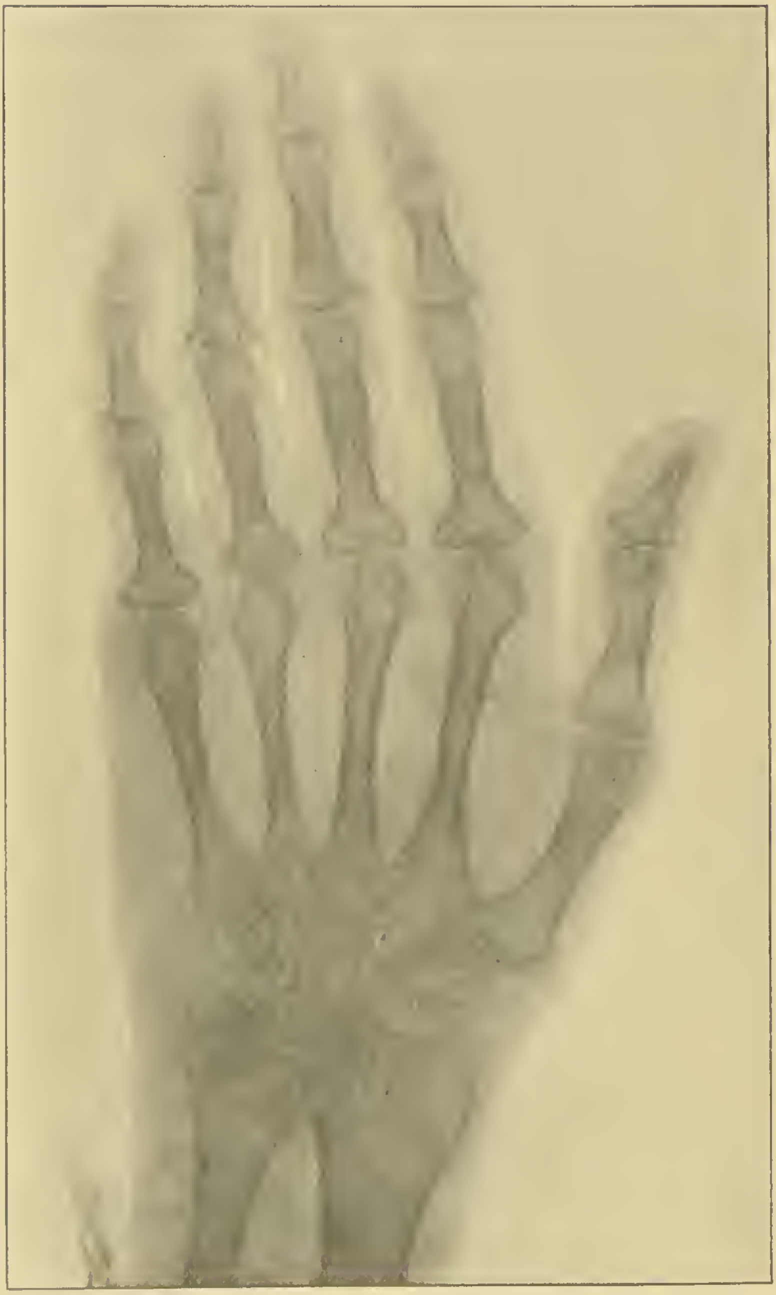

Fig. 31.—A skiagram of a case clinically labelled rheumatoid arthritis. It shows the identical punched-out rarefied areas exhibited in fig. 22; taken from a case clinically labelled osteo-arthritis.

mind more strongly the opinion that all these arthrites are *phases* of infection and intoxication and not definite entities—what is called *typical* rheumatoid arthritis, in my opinion, much more closely resembles severe prolonged affections of the tendons, fasciæ, and muscles, about the joints—*i.e.*, the fibrous structures, which one frequently sees in gonorrhœa, and in which the joint affection is secondary to and dependent upon the hyperæmia and œdema, which naturally, by contiguity, affects the synovial membrane chiefly, and would influence the cartilages least. It may, on the other hand, well be that the rheumatoid arthritis is the analogue of primary *synovial* tuberculosis, while osteo-arthritis conforms more to the *osseous* infection, which distinction does not make either a special entity, but simply a clinical variety.

Etiology (Garrod and others).	*Author's Remarks.*
Age.—The affection may begin at any age; some of the children's joint affections are undoubtedly due to rheumatoid arthritis.[1] Usual maximum liability 20th to 40th year.	In my experience, youth, adolescence, middle age and later, are all affected by osteo-arthritis or rheumatoid arthritis in one form or another.
Sex.—Females 3, to 1 male. Statistics do not discriminate between osteo and rheumatoid arthritis.	
Predisposing.—Anything	In the adjoining state-

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[1] See Still's Disease, p. 164.

> which lowers the general standard of health: periods of worry and anxiety, nursing of sick friends, work under non-hygienic circumstances, *lowering maladies — especially*[1] INFLUENZA.

Disorders of the genital organs may play an important part in determining the far greater liability of the female sex to rheumatoid arthritis. Thus an attack may soon follow parturition or a miscarriage —and that, therefore, the uterus has been the source of infection is an obvious deduction — menorrhagia, dysmenorrhœa, &c.

Of recent years stress is laid upon infective foci of various kinds as originators of rheumatoid arthritis, and in a *small* proportion of cases such foci are to be found—especially pyorrhœa alveolaris; affections of the naso-pharynx, and ulcerated

ment is there a single statement which would not apply to any form of disease with equal force? It certainly does apply to *osteo*-arthritis in general.

Surely this bears out most clearly the septic or toxic theory in its present form which the author mentions in the next paragraph and disposes of in a few words.

Schüller claims that his dumb-bell bacillus is the cause of the affection. The whole of my experience points strongly against a definite cause of this kind, and is in favour of a multiplicity of bacterial processes.

Clinical investigation

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[1] The italics throughout are mine.

piles may be mentioned. Moreover, in some cases treatment directed to such a focus has brought about rapid amelioration, or even complete recovery, of the inflamed joints.

It is doubtful, however, whether these cases are really examples of the *specific* disease rheumatoid arthritis — assuming that such a specific disease exists—and not examples of other forms of infective arthritis, which mimic it more or less closely.

and treatment has led me to attribute most importance to genital infection as a cause of rheumatoid arthritis.

Throughout, Dr. Garrod and others claim rheumatoid arthritis as an entity quite distinct from osteo-arthritis and the indiscriminately septic infections. Surely they do not for a moment claim it is a non-bacterial process?

Dr. Llewellyn Jones adduces very strong support for a gastro-intestinal origin and for influenza; which, he pertinently states, has a marked effect upon the nervous mechanism. It is possible that the combination of a trophic influence with toxic or bacterial activity might explain the difference between the rheumatoid and osteo-arthritic groups, did one not remember that the nervous arthropathies *resemble very much closer*

In the great majority of cases careful inquiry and examination, which should never be omitted, fail to reveal any local focus of infection, and the onset of the rheumatoid arthritis is as little capable of explanation as that of most attacks of rheumatic fever.

Even predisposing (?) causes are often not to be traced, and the malady commences at a time when the patients believe themselves to be in perfect health.

Morbid Anatomy.—Whereas our knowledge of the morbid anatomy of osteo-arthritis is very complete, that concerning undoubted cases of rheumatoid arthritis in the active stage, as distinguished from its sequela, is very scanty.

the osteo than the rheumatoid group.

Does Dr. Garrod mean to say that these patients were examined by rhinologists, gynæcologists, dentists, radiographers, &c.—*i.e.*, men competent to thoroughly examine and report upon the absence or presence of septic and other infections in the departments specially studied by them. My experience is that very few medical practitioners are at present competent to express an opinion on either the mouth or nose.

In such a difficult subject as this surely every precaution should be taken before stating there was *no* septic focus.

The condition of the vagina, uterus, &c., offers ample problems in this direction, as any surgeon knows but too well from experience.

Dr. Llewellyn Jones clearly shows that from the time of a definite illness to the onset of

The following facts are given as the morbid anatomy. The first authority quoted is Dr. Hale White, who bases his statements upon the *post-mortem* examination of *one* case—a young woman.

(1) There was much fibrous thickening outside the joints, with thickening of ligaments.

The *synovial membranes* were swollen and of a pinkish red colour; synovial fluid was present in excess.

The articular cartilages were in the main unaffected, but there was a very slight erosion of the cartilage covering the external condyle of the right knee.

There were no outgrowths from the bones nor from the edges of the cartilage (*macroscopically*). In a word the disease was not one of bone or cartilages but of the synovial membrane and peri-articular tissues.

Microscopically, sections

rheumatoid arthritis, connecting symptoms occur—such as neuralgias, muscular cramps, circulatory disturbance, *i.e.*, pallor and coldness of the fingers, &c., which later become arthritic.

Gastro-intestinal disturbance, however, is the outstanding feature of these cases.

Even at the best the morbid anatomy is quite insufficient to base an entity upon.

Just as in the case of arthritis due to tuberculosis, the infection may begin primarily in bone or cartilage, the exciting cause in both being the *T. bacillus*.

cut from a proximal interphalangeal joint, after decalcification of the bones, showed some thinning and erosion of the edges of the cartilage apparently due to pressure of the swollen fringes.

The cancellous tissue of the bones was more open than usual, and foci of inflammation were seen with small-celled infiltration and a relative absence of fat cells.

These bony changes, however, were of an altogether slighter kind than those in the synovial membrane.

Here also the toxic process may for unknown reasons *select* the synovium primarily.

All cases of osteoarthritis do not show lipping or over-growth of cartilage, and every intermediate stage may be seen.

Certain gonorrhœal cases appear to me to more closely resemble the rheumatoid joints in so far as there is a greater tendency to peri-articular swelling than any other *definite* toxic process, and it is not at all improbable that tuberculous toxæmia, *i.e.*, absorption from tuberculous foci in distant places—which are quiescent—may be the cause of *some* of these pronounced synovial forms of arthritis.

These joints not infrequently, in my experience, affect somewhat delicate women, and in a few of the cases a strong presumption and some evidence of tuberculous lesions during childhood has existed.

Bannatyne describes a great development of new-formed tissue in the soft parts in acute cases, and *a general softening of the* CARTILAGES, *with an erosion occupying one-third the articular surface.*

The bones as red, rarefied, vascular and soft.

The *synovial membrane* as softened, pulpy and thickened, bright red from injection and in the *later stages hypertrophy of the villi, which may have undergone* cartilaginous or fatty changes, with the formation of denderitic fringes.

Max Schüller, who attributes the affection to the dumb-bell bacillus he describes, has made a detailed study of the process of formation of the synovial

While I have seen marked ganglia or Morrant Baker's cysts form over the dorsum of the wrists containing rice bodies, the history, course and subsequent progress of the cases are typical of rheumatoid arthritis.

Judging from Bannatyne's statement of the morbid anatomy, one fails to perceive any difference in the pathology of this affection and that due to any subacute toxic arthritis, while his Hale White's and Schüller's reports on the condition of the bones proves there is an osteitis present.

It all seems to me to be begging the question, and that it is a case of the *phase* in which an examination, microscopically and macroscopically, determines the nomenclature.

Like gangrene—which may assume a dry or moist form—the condition of the collateral circulation, the succulence of the tissues, the state of health villi and lipoma aborescens, from the normal synovial fringes.

Although the formation of the synovial villi in rheumatoid arthritis is very general, it is only in exceptional cases that they attain to the extreme degree described by Schüller, and become responsible for the conspicuous and irregular distension of the synovial capsule with corresponding swelling of the joint. (See also Painter and Irving.)

The villous processes when seen during life have a deep red or bluish-red colour, assume various shapes: some slender and thread-like, others tortuous and flattened. They may spring from all parts of the synovial membrane, or may be confined to certain definite regions.

The synovial fluid is scanty in the villous cases. The absence of osteophytic outgrowths and the erosion of the cartilages in *acute* cases is emphasized.

or disease of the arteries (the mode of treatment also), these factors determine whether dry or moist gangrene supervene.

Similarly in these arthritides the vascularity, the succulence, the condition of the blood-vessels and many side effects may determine the clinical characteristics and morbid anatomy of a toxic arthritis.

Thus all the authors quoted describe an osteitis, and Schüller (also Painter and Irving), emphasizes the villous processes present in rheumatoid arthritis, conditions which are said not to occur in typical rheumatoid, but are common in osteo-arthritis. I have previously stated that I consider *the bone lesion* is **THE** lesion, effusion is an incident.

Nearly all details given by various authors are contradicted more or less

Rarefication of the bone for some distance also occurs; while ankylosis is described in a few instances.

In conclusion, Llewellyn Jones contrasts the two conditions, rheumatoid and osteo arthritis, as regards bony ankylosis, which may occur in the former, but rarely occurs in the latter, in which mechanical ankylosis occurs.

The *nervous system* is then closely investigated.

by others. Fibrillation of cartilage, which is stated never to occur, is *given* as *present* by other microscopists.

Any museum will effectively confute this statement.

In the first case recorded by Mott and Tredgold, however, the disease MUST have been one of osteoarthritis, or the whole argument of the adherents of the rheumatoid entity loses all its force, as "considerable osteophytic outgrowths were present," which they say *never* occurs in this affection. Thus, any conclusions drawn from this careful report in favour of *rheumatoid* arthritis as an entity, whether dependent on nervous disturbance or not, is stultified.

Painter and Irving.

The hypertrophied fringes vary both in their appearance and size. The smaller and more delicate, purple in colour, are attached by a slender pedicle to the synovial membrane, whose surface may be studded with these elongated processes.

On the other hand, they may be of considerable size, the so-called lipoma arborescens, when they present a yellowish colour and are coarsely lobulated in shape. These, in addition to their usual pedicle, may be attached by adhesive inflammation over a large area of the synovial membrane.

The *microscopical* examination of the fringes shows that they are enveloped by a layer of endothelial cells, internal to which is

The other cases whose central nervous systems were examined are also doubtful cases of subacute infective arthritis.

Marsh and Watson reserve the term Rheumatoid Arthritis "for those cases of Arthritis Deformans in which the stress of the disease falls on the synovial membrane and periarticular tissues."

I cannot agree with them that osteo-arthritis is *primarily* a lesion of the cartilage which *subsequently* affects the bone.

I learn that with careful clinical and X-ray examination of arthritic cases at children's hospitals *undertaken by the same investigators*, the supposed characteristics "diagnostic" of osteo and rheumatoid arthritis respectively are far from being so in reality, and are found indiscriminately in cases which clinically appear to be differentiated.

On the whole the evia groundwork of connective tissue, infiltrated with small round cells and abundantly supplied with thick-walled blood-vessels, showing endarteritis. Fatty degeneration develops in the deeper layer.

With regard to the presence or excess of synovial fluid opinion varies: most authors claim a slight effusion in many cases.

Llewellyn Jones (p. 74) quotes the microscopical changes seen in later and terminal cases. The main facts indicate vascular fibrosis of the soft structures and atrophy of the cartilages, especially towards the free surface and margins, the centre being least affected.

Painter describes *cartilage and bone formation in the synovial membrane*, with erosion of cartilage laying bare the underlying bone.

In cases of *old* standing there may be complete destruction of the articular dence is strongly in favour of the incidence of osteo-arthritis in infancy and tender years being very frequent; cases showing every characteristic of osteo-arthritis in adults are seen, and of the development of typical osteo-arthritis in later years in joints which were previously the seat of rheumatoid arthritis.

We now have strong evidence of the statements *vide British Medical Journal*, January 15, 1910, that in female infants, in whom this clinical variety of arthritis occurs most frequently, *infection of the genito-urinary tract* by *gonococci*, *Bacillus coli* and other organisms is relatively frequent and probably a determining factor in the incidence of the disease. On the other hand, I have seen joints, in children and adults, which for prolonged periods were diagnosed and treated as osteo or structures. Firm fibrous bands surround what was once the articular cavities, the cartilages may be entirely destroyed, and when fixation has been complete bridges of cancellous bone may stretch across from one surface to the other.

There may be some proliferation of bone with the formation of sharp spicules, which are very unlike the rounded osteophytes of osteo-arthritis, and bear no relation to the intensity or duration of the disease (see diagram 28).

The *visceral lesions*, as quoted by Dr. Llewellyn Jones, point to a general toxæmic process, as may be commonly associated with any form of arthritis. rheumatoid arthritis finally break down as typical tubercular joints. Hence in children, hidden tubercular lesions—distilleries of tuberculous toxins—may, just as Still has shown of syphilis, be a contributory factor of the highest importance in producing the acute infection known as rheumatoid arthritis, which, in the absence of the tuberculous lesion, would have remained normal, or in the presence of merely a septic focus have become typical osteo-arthritis.

It is overlooked in all discussions on the question of rheumatoid *versus* osteo arthritis, that if the joint affection is a painful, prolonged one — which precludes use and function almost entirely—the terminal pathological condition will differ in many respects from a chronic affection which *permits* of use and function.

This question might

reasonably be put on a par with endocarditis, the pathological conditions in which vary so much—according to intensity, virulence of the germs, chronicity, &c.—and in which the clinical manifestations are also so variable. We now know this is all a question of degree, and may be induced by almost every known coccus.

Premonitory Symptoms, in parts liable to rheumatoid arthritis.

- *Vaso-motor.*
  - Asphyxia or syncope—
    - In certain fingers and portions of the extremities.
    - Local sweatings.
    - Local œdema.
- *Motor group.*
  - Muscular—
    - Spasm-cramps.
    - Weakness.
    - Wasting.
- *Sensory group.*
  - Paræsthesiæ—
    - Tingling, numbness.
    - Pins and needles.

These, however, are common to other affections not arthritic and are but signs of toxæmia.

Stinging.
Soreness.

Local pains referred to the articulations.

Referred nerve pains: sciatica, neuralgias.

Increased tendon reflexes.

Modes of Onset.

(1) Acute.
(2) Subacute.
(3) Chronic.

The acute and subacute cases are apt to be mistaken for rheumatic fever and are only distinguishable by their persistence and course, but the general symptoms and history often help to exclude this.

Distribution.

It begins in the small joints of the hands, especially the proximal interphalangeal articulations.

Then the wrists, ankles and knees, and almost any joint, though the hip is most immune. It affects the temporo-maxillary joint and the vertebra.

Garrod says stiffness of the jaw and neck may help

My personal experience has been that intermediate degrees between the acutest pseudo-rheumatic arthritis and osteo-arthritis occurs.

In young boys one finds cold, clammy feet and hands liable to be involved in an arthritic process; in later years they develop typical osteo-arthritis in other joints, while hallux valgus and other deformities occur in the affected feet. The whole differentiation revolves upon the character of the swelling. Almost every statement made with regard to to differentiate rheumatoid arthritis from rheumatic fever. It advances from periphery to centre in conformity with the neuropathic theory of its causation.

Clinical Features.

- Pain.
- Limitation of movement.
- Swelling.
- Atrophy of muscles.

The pain in the joint is variable and not always in relation to the severity of other symptoms. It is present even when the patient is at rest; aggravated by movements, increased by warmth of the bed. It does not shift from joint to joint like rheumatic fever.

Extension of disease results in additional pain. It affords no clue to the prognosis.

Pain due to spasmodic contraction of the atrophied muscles — cramp, limited in its distribution and leading in this arthritis,

rheumatoid arthritis has its prototype in osteo-arthritis.

The symptoms and signs given by Dr. Garrod have so many exceptions and qualifications that one feels at the end of the perusal that the differentiation of the two diseases is artificial and strained.

as in all others, to aggravation of the arthritic pain.

Also referred pains due to vertebral disease affecting the nerves at their exit from the intervertebral foramina.

The swelling is usually an early symptom, but it may *be wanting even though pain is* pronounced.

Its character is due to synovial and peri-articular thickening ; it is therefore fusiform and spindle-shaped.

There is usually some synovial effusion and also swelling of the adjacent bursæ.

In the later stages the synovial fluid is apt to be viscid and like melted jelly.

On *palpation* it is evident the swelling is of the soft parts, in and around the joints, and in the *active* stage no lipping of bone nor osteophytic outgrowths are felt.

The X-rays show that the articular *surfaces* are apparently unaltered, and the

How this statement can be justified I do not understand.

translucent line of cartilage intact. *There is a peculiar rarefaction of the bones near the articular surface.*

In some cases the swelling is due to distension of the capsule with hypertrophied and arborescent villi which fill the cavity.

Moderate hypertrophy is usual, but this excessive condition is revealed during life by the fact that the swollen joints are felt to be filled with soft—solid material with irregular surface, especially in the knees.

The absence of conditions characteristic of well-developed osteo-arthritis will be noted.

Limitation of movement is generally well marked.

Atrophy of muscles is typical of arthritis, *i.e.*, greater than that of disuse, and affecting disproportionately certain muscles, and when the joints move freely exaggerated tendon reflexes accompany it. It is in some cases most

Shenton says, "It will be noticed that joint disease is rather mixed up with bone disease, but my excuse is that the radiographer does not, strictly speaking, see the joint surfaces, and bases his conclusions on the adjacent bone tissue."

While stating the disease is "of the soft parts," yet conclusive proof of bone rarefaction is given. Whether this is temporary or permanent is not stated.

This is so because of the pain.

marked, and leads to contracture and deformities; but the joint condition and the atrophy are not by any means in relation to one another. In some cases marked deformity results in a very few months, and the musculature of the limb becomes reduced to a mere minimum; while in severe cases so many joints are involved as to reduce the patient to a considerable degree of emaciation. The greatly atrophied muscles, with the fusiform enlargement of the joints, is a very striking feature when it involves a considerable number; and the degree of crippling may be startling in its rapidity and extent.

Thus, in the *stage of sequels*, owing to contracture and shortening of the muscles—while the joints were maintained in a state of flexion—ankylosis and subluxation are frequent.

The deformities of the fingers are particularly marked, and resemble those due to contracture from nervous lesions and other causes irrespective of joint lesions. The metacarpo-phalangeal deformity producing ulnar deviation is very common.

The joints themselves may be so seriously damaged that the incapacity of the patient is seriously increased thereby. In severe cases of long standing, *post-mortem* examination may show the cartilages to be completely destroyed, and during life there may sometimes be felt, especially in the knees, a peculiar scraping as of one bony surface upon another.

Bony excrescences may develop around the articular surfaces; but, unlike the ordinary osteophytes of osteo-arthritis, these are rather bony spicules, which are often peculiarly sharp pointed. They are also unlike the bony bosses and projections seen in Charcot's joints.

Subcutaneous nodules of larger size, much more tender and permanent in their nature, are found in this form of arthritis. They may be situated in bursæ or soft tissues near the joints or at a distance from them.

Cutaneous changes in the form of trophic lesions and pigmentation are frequent.

The trophic lesions are similar to those associated with injury and other nerve lesions.

The pigmentation is scattered over the body in any position ; its tint varies considerably—from lemon to the darkness of the mulatto.

Œdema of a solid nature occasionally occurs in the feet, and is no doubt due to the postures long maintained by crippled patients.

CONSTITUTIONAL SYMPTOMS.

The temperature is variable in some cases, only slightly elevated in others; it may be as high as 103°. Periods of high temperature occur with intervals of apyrexia. Here, again, the temperature and activity in the joint are not in proportion.

Circulatory disturbance with increased heart frequency, even as much as 110, may take place, and milder degrees persist for years unchangeably. The temperature and pulse do not bear a definite relation to one another or to the joint lesions.

Collateral phenomena, which accompany and often succeed the arthritis, are really the premonitory symptoms which persist.

Muscular—
  Irritability, *i.e.*, spasm.
  Tremor.
  Atrophy.

Various muscular phenomena, suggesting amyotrophic lateral sclerosis.

Muscle—
  Tendon irritability generally.

Increased superficial and deep reflexes (more rarely they are absent).

Vasomotor phenomena.

Lymphatic glandular enlargement, which is generalized eventually, but of varying degree.

The general health must obviously suffer.

RHEUMATOID ARTHRITIS IN CHILDREN.

Quoting from Llewellyn Jones, it would appear there are at least four varieties of disease in this category :—

(1) A condition clinically comparable in all its course to rheumatoid arthritis as seen in adults.

(2) Rarer cases which correspond to osteo-arthritis, both localized and generalized, of adults.

(3) Still's disease—*i.e.*, a chronic progressive enlargement of the joints associated with enlargement of the lymphatic glands and spleen.

(4) Rhumatisme fibreux, in which the joints show peri-articular thickening of a fibrous nature without any evidence of bony changes.

Rheumatoid Arthritis.

Of the etiology little is known. Some attribute importance to environment — damp, cold, poverty, insufficient food, and defective hygiene generally.

Still noticed a conspicuous absence of these conditions. Gout, diabetes, rheumatism, Graves's disease, and insanity in the parents have been observed. Some of the children gave a history of infantile disorders, others did not.

The absence of value of the foregoing statements in elucidating the cause of the disease is obvious.

Age.—Unknown before the age of two years. Still's disease has been observed earlier than this.

Sex.—Chiefly females.

Morbid Anatomy.—The records are few and the general findings show—

A. *Joint changes*, subcutaneous tissue œdematous, discharging abundantly serous fluid.

Tendons and sheaths normal.

Capsules thickened but contained no excess of fluid.

Cartilages, seat of erosions, chiefly central.

In the fingers, thickening of peri-articular structures; the cartilage in one joint destroyed, in others intact; osteo-myelitis present in some of the bones.

B. Capsule showed connective tissue thickening, while the cartilage, to a large extent, had lost its normal sheen, was rough, uneven, and here and there completely atrophied, being replaced by connective tissue.

Microscopically, capsule revealed connective tissue, &c.

Cartilage.—The outermost layer of hyaline cartilage had undergone gradual transformation into connective tissue, the latter extending at the expense of the former. In some places the transition was abrupt.

In the deeper layers the cells were irregular in character and arrangement, while some were seen to have undergone degenerative changes. Ultimately the layer of cartilage cells is replaced by connective tissue overlying the bony trabeculæ and enclosing here and there among its fibres effete cartilage cells.

C. All the articulations of the foot were opened; the morbid characters were: The synovial membrane as well as the greater part of the ligaments were thickened owing to the presence of a gelatinous soft connective tissue, with numerous projections up to the size of a bean.

Microscopically it showed fine connective tissue with intervening loculi and abundantly supplied with blood-vessels.

Section of the bones showed extensive osteo-porosis. The bony trabeculæ were exceedingly fine, enclosing large cavities filled with abundant red-marrow.

Right Knee-joint, &c.—Peri-articular and capsular structures and the crucial ligaments, seat of gelatinous œdema. The cartilage was intact.

Generally speaking, a considerable amount of fluid was present in the joints. The effusion was viscous, yellowish with some fibrin flocculi (non-purulent).

D. Microscopical examination of the synovial membrane revealed an extraordinary number of nests of round cells.

Jones observes: "Reviewing these autopsies the salient pathological feature is the intact condition of the inter-articular cartilages in the EARLY stage of the affection. Later they undergo erosion. They, therefore, are strictly comparable to those observed in adults.

"The primary changes take place in the synovial membrane, the cartilage is secondarily involved, and the latter is purely regressive in character and unattended by new bony formations, contrasting in this respect with osteo-arthritis."

To my mind the skiagram published by Jones shows as a SALIENT fact the *marked thinning* of bone, not only in the proximal inter-phalangeal joints which are supposed to be diagnostic, but also in the distal ones of ALL the fingers and the metacarpo-phalangeal articulations also.

From the evidence one could with justice remark that the disease was rarefying osteitis with articular and peri-articular œdema.

Diamantberger states that the changes in the ends of the bones sometimes lead to arrest of growth in the skeleton, and notes that inequality in the length of the femora and tibiæ may result.

In three cases he has observed lack of development in the lower jaw ; when one remembers the condition of the bones at the ages referred to, a considerable amount of cartilage is present and we do not expect it to react like bone.

The criticism of the disease in adults holds good here. The *clinical features* are similar to those in adults, except that splenic and lymphatic enlargement is said to be frequent. The association of some variety of goitre is not infrequent. In short the evidence of a general toxæmia is very well marked.

STILL'S DISEASE.

CAUSE unknown.

Age before second dentition, earliest fifteen months, the majority before third year.

Sex, girls more liable than boys.

Morbid Anatomy.—In two cases of fourteen months standing the markedly enlarged joints showed only increased vascularity of synovial membrane and ligaments, with slight increase of synovial fluid and thickening of the capsule ; in one case this was very obvious.

In *an advanced case* of three years standing there was in addition some pitting of the cartilage at its margin. A rather worm-eaten appearance due to pressure atrophy by enlarged villi.

There were some fibrous adhesions in the joint. The fibrillation of the cartilage *which is so characteristic of rheumatoid arthritis,*[1] even in its early stages, was absent in these cases, also osteophytic outgrowths and eburnation. The glands and spleen were considerably enlarged. The pathology of the disease suggests a microbic origin (Still believes syphilis plays a considerable part in joint affections in children).

In Whitman's case there was present *amyloid* degeneration in the liver, spleen and mesenteric glands. The affected joints contained much mucoid *granula-*

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[1] Put in italics to show how confused is the knowledge of rheumatoid arthritis ; this statement would be emphatically repudiated by those who consider rheumatoid arthritis an entity.

tion tissue, which had in places produced worm-eaten erosions of the cartilages. The cortical substance of the bones was exceedingly thin, as were also the cartilages. No micro-organisms were found and the author believed the disease began in the synovial membrane.

Various authors believe these joint affections of childhood are probably of tubercular origin—a tubercular toxæmia. All these joint affections in children are really too undecided in origin to be written of in any dogmatic manner.

The **clinical signs and symptoms** of both Still's disease and rheumatoid arthritis are very similar. Thus *Still's disease* may begin in an insidious manner, or with a rigor, chills, and fever, stiffness with gradual enlargement of a spindle-shape swelling. The wrists, knees and cervical spine are usually first affected, then the fingers, and later the toes. The swelling suggests peri-articular thickening, there is none of the bony irregularity of rheumatoid arthritis, and the absence of bony thickening and lipping, even after the disease is considerably advanced, is striking. Bony grating cannot be obtained, but creaking of tendon or cartilage is frequently present. Effusion is seldom a marked feature. Tenderness if present is usually slight. There is generally some limitation of movement. Eventually the children become bedridden. The disease is generally symmetrical. There is no tendency to suppuration nor to bony ankylosis.

The *muscles* waste considerably and undergo contracture, generally producing flexion.

The *lymph glands and spleen* are generally palpably enlarged. The glands draining the particular joints are first affected, then the condition becomes more general. The glands are discrete, firm, not tender, and show no tendency to break down. They may be so large as to be visible. When joints improve the glands subside to some degree.

The *spleen* is generally but not invariably palpable. *Vascular* disturbance consisting in hæmic bruit, but no valvular lesion. There is moderate anæmia. Sweating is profuse. There is often slight prominence of the eyeballs not associated with any enlargement of the thyroid. In early onset, *i.e.*, before second dentition, there is marked arrest of bodily development. The temperature in some cases is almost continuously raised, in others periods of pyrexia alternate with apyrexia. The *course* is slow. Temporary improvement may occur, crippling invariably occurs, and some intercurrent disease carries off the child, so that while the condition itself rarely kills, recovery is rare, although fortunately complete recovery has been recorded. A recovery has been recorded by Whitman after treatment by arthrotomy. An inflammatory disease occurring in these cases has several times been followed by improvement in the joint condition. Occasionally pigmentary conditions and some trophic changes in the skin are observed.

DIAGNOSIS.—When there is an acute onset the disease is generally mistaken for acute rheumatism. The persistence of the joint condition with enlargement of glands and the spleen elucidates the condition. When the cervical spine is involved caries may be simulated.

Rickets has been diagnosed in some instances, but the bony changes are absent.

Tuberculosis is excluded by the number of joints involved and its symmetry, and the absence of a tendency to caseation (much too sweeping a statement in my opinion). Of recent times it has been asserted that some of these cases are due to *tuberculous toxæmia*, as they react markedly to injections of tuberculin.

Arthritis in congenital syphilis may easily be mistaken for it, but the history and association of other syphilitic lesions distinguishes them.

The Treatment of Osteo- and Rheumatoid Arthritis.

The local treatment may be summed up in :—

(1) The application of dry heat and other measures to relieve the pain, and which stimulate the nutrition of the part.

(2) The avoidance of too much use and strain of the joints, *i.e.*, *modified rest*.

(3) The maintenance of active (and passive) movement.

(4) The removal of fluid and irregularities on the joint surface.

(5) Operative interference in suitable cases.

HOT-AIR BATHS AND DOUCHES.—As a general rule one may lay down that the more chronic the joint is, the better will hot air be borne and the better its effect.

While the more acute the joint the more suitable is a congestion bandage.

Heat may be applied to a joint in various ways.

(1) As heated dry air in a chamber (Bier's or Tallerman's), or in the form of a hot-air douche.

(2) As radiant heat—electrical.

(3) As hot sand, salt, and other dry minerals.

(4) As a dry application, cotton wool, Gamgee, spongiopilin, moss dressing.

(5) Leiter's tubes.

Moist Heat :—

(1) Fomentations, baths, mud baths, hot lotions, compresses.

(2) Constant irrigation and douches.

Also in the form of rubefacients, vesicants, the cautery, &c., heat may be generated locally in the form of a superficial inflammation.

I am convinced that the most efficacious remedy in the relief of pain and promotion of absorption is hot, dry air; especially in certain chronic obstinate cases, this is beneficial in the form of a douche impinging on to the skin directly.

Bier's hot-air chambers or modifications thereof are the simplest and most effective (see p. 500). The joint is exposed to as great a heat as can be comfortably tolerated for one hour or less; it is then dried and thoroughly massaged by stroking, kneading, and rubbing for fifteen minutes, wrapped in a warm covering and rested for a few hours.

Osteo-arthritic joints are very susceptible to the influence of draughts and colds.

If *movements are restricted* exercises directed to increase them are taken immediately after the bath, and an increasing range attained from day to day.

Active movements on the patient's part are infinitely the more valuable, but passive movements will be more efficacious at first in stretching tightened ligaments or adhesions, if active movements are restricted or the patient refuses to aid on account of increased pain.

FORCED movements must never be attempted, they only increase pain and produce exacerbations.

The treatment requires considerable care as it tends to exhaust feeble or aged patients, and my experience is that most of these cases require good nourishing food, and to be placed under sound hygienic conditions. If, therefore, an hour is too prolonged it is best to reduce it to half or three-quarters; usually it is wiser not to employ the air bath more frequently than once in twenty-four hours, although in robust patients with a single joint a hot-air bath may be given in the morning for one hour, and a hot-air douche for fifteen to thirty minutes in the evening.

If many joints are involved Bier recommends either:

(*a*) The treatment of certain joints by passive congestion (which is conservative rather than exhausting) and the use of the hot-air bath for others; or

(*b*) He says use the hot-air bath for the worst joints —almost always use it for the knee—and as these improve so the others also tend to improve.

(*c*) Or the alternate treatment of affected joints.

(*d*) *If the patient is strong and vigorous* full use of the baths may be made in this way: both legs are bathed in the morning for two hours, both arms are bathed in the evening for two hours.

The *spine* is treated in a special bath, but it reacts excellently to hot-air douches, which alone may therefore be used if expense is any object.

Ewart recommends an interrupted circulation method, which relieves pain, and during the wearing of the bandage permits of passive movements of the joints :—

The limb is avascularized as in Esmarch's method by elevation and stroking over the veins, then a tight bandage or tubing is applied over a protecting layer of lint on the thigh or upper arm. This constriction is maintained for thirty seconds to two minutes and then relaxed, so flushing the limb with blood for an equal length of time. This is repeated three or four times at a sitting daily.

In CHRONIC CASES after a course of hot-air baths extending over one or more months, it is wise to discontinue them for one to three weeks and to use—

(1) Either passive congestion, or
(2) The usual stimulating methods in vogue (see p. 48).

During this interval I personally prefer the grey wool compress (see pp. 46, 93) worn for three or four hours night and morning, if only one or two joints are involved. Two or three times a week I put on an alcohol compress for two hours with firm pressure, generally on one joint at a time. These methods are combined with massage daily.

If much stiffness exist or if mechanical interference with the movements of the joint is present *excessive violence must be avoided*, adhesions, &c., must be *gradually* stretched and broken down, and rough cartilages *gradually* rubbed smooth.

Unusual exertion or forced movements generally produce exacerbations, and "breaking down adhesions" are best avoided. In certain selected cases, an anæsthetic and breaking down may be indicated, but these cases are not numerous.

In this disease prevention is the essential treatment and breaking down must be entered upon cautiously. Hence even in acute cases *absolute* rest is never to be used. Modified rest is the correct treatment. SPLINTS will certainly lead to permanent stiffness and partial ankylosis.

Modified rest means that no great weight or strain is to be put on any joint, but full active or passive movements *must be carried out* daily; it may take quarter to half an hour to effect such movements, but made they must be, as in the acutest attacks coagulable lymph is effused either into or about the joint, and sticking of the synovial folds or tendons takes place. With some form of dry heat and very gentle stroking preceding all attempts at movements, these may invariably be carried out.

Also the proper application of a Bier's compression bandage will relieve pain sufficiently to enable active movements to be performed.

The essential treatment therefore is:—

(1) To remove the primary infection.

(2) To afford modified rest.

(3) To treat the *acutest joints* by Bier's compression bandage or the grey wool compress till they subside into—

(4) The subacute and chronic joints by hot-air baths and douches.

(5) Massage gently carried out.

(6) NEVER to use any fixative apparatus.

Occupations which need manual exertion are to be strongly encouraged. Piano playing is especially useful, and all domestic duties and actions should be performed. Elastic, gymnasium, mechanical (Zander, &c.) and all other forms of exercises are valuable. A stationary bicycle affords a good means of exercising the lower limbs. The practitioner and patients' ingenuity may readily evolve suitable modes of exercise. The important thing is not what the exercise consists in, but in the doing of it.

The General Treatment.—As sepsis is no respecter of persons, so we find osteo-arthritis in the wealthiest as well as in the poorest class. With few important exceptions, however, they all sooner or later tend to physical deterioration, and in the main a good nourishing *régime* is necessary.

Equal attention should be given to the general health and surroundings in a severe case of osteo-arthritis as is devoted to it in phthisis and other debilitating diseases, but it is obviously fatuous to send patients to spas, sanatoria or to warm equable climates and expect anything more than a temporary improvement directly due to the beneficial conditions, *if they convey with them the septic infection to which the osteo-arthritis is due.*

Treatment of the latter indeed will in the greater number of cases obviate the need for the former.

In a case which exhibits none of the ordinary forms of sepsis—mouth, bowel, genito-urinary—a thorough examination of the nasal accessory sinuses frequently reveals the septic focus.

In women the condition of the genital organs calls for equally thorough examination, and owing to the delicacy attending this part of the investigation, failure to obtain satisfactory information will often be met with.

Yet if the importance of the matter is clearly explained and the patient or her mother's attention directed to it, information of a positive character will often be obtained, or an examination permitted. I am convinced of the great prevalence of vaginal infection amongst just the type of young woman who is liable to the acute polyarticular osteo-arthritis. It is usually a mixed infection.[1]

The vulva is very frequently infected in childhood, and in adolescence such a degree of infection exists that leucorrhœa or cystitis may be present, which results appear to the patient as the normal state, while in reality the condition is that of a genital infection.

I am convinced of the importance of removing *all* conditions of a septic nature, each of which in itself might be too insignificant to produce an arthritis, yet in the sum total do suffice to produce a sufficient toxæmia to result in arthritis.

I think that recurring influenza is an important cause of exacerbations in osteo-arthritic patients, and the result of recent investigation goes far to show that this condition is due to infection of the nasal accessory sinuses with the influenza bacillus. The same applies to common colds and catarrh to a lesser degree.

I have recently seen two cases, both in young male adults, in one of whom the head and neck of the right side of the lower jaw disappeared within a month, and in the other a finger-joint completely disintegrated in three weeks, and in neither of whom could I trace the source of the sepsis, except that one had recently had a virulent cold, the other an attack of influenza.

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[1] I have been informed by those best qualified to know that even amongst the members of leading women's colleges, *i.e.*, *members of good social standing*, leucorrhœa in a mild form is very prevalent, and its treatment is followed by disappearance of many symptoms not ordinarily attributed to this affection, but which, as proved by treatment, must have been toxic in origin.

On the other hand I saw a typical attack of acute arthritis in a woman of 44 in whom the external extremity of the clavicle and the adjacent acromion rarefied and disappeared within a few weeks with the semblance of an abscess; this all cleared up after dental treatment and the local application of heat. She had typical chronic osteo-arthritis of her opposite shoulder.

Generally I find that meat is so often omitted in the dietary of these patients, that I wish to impress upon my disagreement with this advice; in the presence of disturbed digestive organs, so common in these patients, a considerable amount of indigestion exists and meat may produce bad symptoms, but so in a great number of cases do carbo-hydrates, especially diets rich in sweets, and on the whole I believe the sugars do more harm to arthritic patients than does meat.

I am not concerned about purins, nor do I really think they deserve all the evil spoken of them, in so far as my practical acquaintance with arthritics shows, and as is well known the *vegetables* rich in proteids are often rich in purins.

A good nutritious mixed diet is best.

As many patients drink too little water, the imbibition of water, hot or cold, morning and evening, is desirable.

The function of the bowel is usually disturbed, constipation is very frequent, and the administration of a *daily* laxative is highly beneficial. Cascara, phenol-phthalin, compound liquorice powder, fruit confections, mixed confections of jalap, senna, sulphur, and occasional doses of a brisk purgative are needed. I do not favour salines, as my experience shows they tend ultimately to increase constipation. The only effective means of "disinfecting" the bowel is to repeatedly wash it out by means of brisk purgatives followed by daily laxatives.

We know it is quite impossible to *disinfect* the bowel and its contents, but as regular removal of effete products is tantamount to this in actual practice, I never give so-called intestinal antiseptics but use laxatives instead.

Minute doses of calomel daily, or the administration of liquid paraffin in emulsion or capsules acts beneficially.

In *urinary sepsis*, whatever other treatment may be needed and adopted, I nearly always give :—

Hexatetramethylamine, urotropine, or helmitol	gr.iv
Tinct. hyoscyami	♏xv
Aquam ... ... ad	℥i

Every three or four hours.

Preferring *continuous* administration of smaller doses of the drug to larger doses at more frequent intervals.

If bacteriuria or septic conditions of the urethra and bladder exist they must be treated appropriately. The bladder should be washed out with the strictest aseptic precautions,[1] else the infection is increased instead of diminished. Potassium permanganate, followed by silver nitrate, is by far the best means of cleansing the bladder and urethra.

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[1] *See* "Sterilization of Urethral Instruments," by H. T. Herring (Lewis's).

Lavage of the bladder should be carried out daily, using one to two pints of 1 in 4,000 potassium permanganate, then one pint of saline through a double-way catheter, the outlet being occluded from time to time to distend the viscus slightly. After the saline about 8 oz. of 1 in 10,000 silver nitrate solution should be used. For the urethritis, see Gonorrhœa p. 185.

Drugs.

Sedatives, tonics and other drugs I do not use to any extent *until the septic focus is seen to*, as otherwise patients are apt to rely on the drugs and ignore the sepsis and its treatment, but one must be guided by circumstances.

The acuter cases certainly benefit by *big* doses of salicylate of sodium, while aspirin and iodide of potassium afford more relief in chronic cases.

Guaiacol carbonate, creosote and the "antiseptic" treatment has not given me much satisfaction. Guaiacol and iodide of iron combined is recommended by Luff. All drugs must be given for prolonged periods. Quinine sulphate and hydrochloride are extolled by certain authors.

Local applications of the oil of winter green type, mesotan, Bengué's application, and ionization with the anti-rheumatic drugs relieve the pain quickly. The ointment or liniment of iodide of potash is always my first string.

In *chronic cases*, where hot-air or the congestive treatment is not followed or has failed in the individual case to effect relief, the methods in ordinary use must be followed, but I must again impress upon the absolute necessity to avoid SPLINTS, and COMPLETE REST.

Warmth, depletion and counter-irritation, application of specific drugs, and pressure, these are the common methods.

But I wish to draw attention to the intensive method of administration of drugs by ionization, which I believe is extremely valuable in relieving pain and stiffness, and thus permitting of an ambulatory method of treatment, whereby the use of the muscles may be encouraged and the general health improved, thus breaking the vicious circle usually present. Warm clothing and everything which experience teaches is desirable for the subject of rheumatic fever is also suitable for these cases.

For a full review of treatment of these joint conditions Llewellyn Jones's book (Wright, Bristol) on Arthritis Deformans should be consulted.

GONORRHŒAL ARTHRITIS.

In my opinion gonococcal urethritis is more often followed by teno-synovial inflammations and affections of the fasciæ and fibrous tissues than it is by synovitis and arthritis. Casper says 2 per cent. develops arthritis.

Pure cultures of the gonococcus may however be obtained from joints, but in the majority of cases the *severe* joint affections are due to mixed infection—gonococci and the pyogenic cocci.

Schüller states that *micrococci* are invariably present in almost every other bacterial type of joint infection.

It may arise within a few days of the appearance of a discharge and especially so in those cases in which a severe posterior urethritis is set up early, or it may not appear until the chronic stage or gleet. It most commonly develops, as one would expect, at the height of the urethral inflammation in from three to six weeks, and is apt to supervene in cases which have been manipulated by instrumentation or improperly constructed syringes, or by the use of too powerful injections, *i.e.*, by anything leading to a gross breach of surface or followed by strong inflammatory reaction. It also complicates primary gonorrhœal infections of other parts of the body, irrespective of the urethra.

The knee is more often affected than all the other joints combined, like osteo and rheumatoid arthritis it affects the small unusual joints, the clavicular, temporo-maxillary, costo and chondro-sternal, &c., articulations.

It more often arises during severe first attacks, probably conduced to in part by the inexperience and mismanagement of these patients.

Many patients, however, are susceptible to recurrence of the arthritis at the slightest recrudescence of a gleet or a return of, or so called new (?) attack, of gonorrhœa.

I have carefully examined patients attacked with gonorrhœal arthritis and find a large proportion of them are the subjects of other septic lesions such as are associated with osteo-arthritis (*vide* p. 116), and believe the joints are predisposed to attack by any sudden increase of the existing or a new form of toxæmia. They are generally active subjects, many of them athletic or engaged in laborious occupations, or such as render them prone to strains.

That excessive use and slight trauma are predisposing is evidenced by the great frequency with which the much used tendons of the thumb and fingers are involved and that in a *great majority* of the cases the knee is involved.

The question of *inherent susceptibility* on the part of the patient is difficult to prove, but that the *virulence of the gonococci* may be very great in some cases has been proved experimentally, and thus liability to infect joints in every person infected by the particular strain is very potent.

The Clinical Varieties.

- (1) *Acute*
  - Non-suppurative
    - Without much effusion into the joint—dry form.
    - With effusion — moist form.
  - Suppurative.

(2) *Chronic or insidious* from the first, beginning as a painful swelling with impaired movements and progressively extending. Transient or fleeting pains in a joint may precede an attack for some days.

The Acute Non-suppurative Conditions.—As no distinct differences really exist it is artificial to separate these cases; some of them show a greater degree of peri-articular inflammation with œdema, redness and an irregular-shaped swelling, while others appear as a definite synovitis. The description given of Acute Synovitis (p. 34), or Arthritis (p. 57), applies to this form of joint affection.

Certain distinctive characters may help in the diagnosis.

(1) That in spite of what may be a very alarming local condition, the pulse and temperature .do not correspond with it, the temperature is not so high and has no great excursions as in a septic (*i.e.*, pyogenic, pyæmic) case, or it does not keep up, but soon drops to a moderate degree, perhaps 99° to 100°, and soon less than this.

(2) The local condition after a few days, instead of increasing in virulence from day to day and showing evidence of constant progress towards abscess formation, soon tends to attain a maximum; it may then remain stationary, or even improve to a slight degree. It does not become so boggy and soft in definite places as it does if an abscess is developing.

(3) Often the adjacent tendon sheaths are simultaneously involved; indeed peri-articular inflammation is invariable and may constitute a great part of the swelling, which is then brawny, very hot, red and tender, with areas over the tendon sheaths which fluctuate more or less and creak on movement.

(4) Fasciæ, such as the plantar, fascia-lata, and the scalp are often very painful and sensitive to pressure. Dr. Mitchell Bruce taught that the second toe is very liable to gonorrhœa, just as the big toe is affected by gout. The fasciæ of the foot and especially the under aspect of the heel are frequently very painful and tender.

(5) *There is an accompanying urethral discharge,* or in the female a well-marked leucorrhœa, or a recent extension of inflammation into the urethra or involving a Bartolini's gland. In the male the onset of a joint rarely causes an entire, but temporary, disappearance of a discharge; it often happens that there is some diminution of the discharge a few days before the arthritis develops.

(6) The *association* of joints with other gonorrhœal complications: myositis, iritis, conjunctivitis, scleritis, neuritis and meningo-myelitis, &c.

In ACUTE RHEUMATISM it is usual to find the general signs of fever more pronounced and more prolonged if untreated, also

(*a*) The result of salicylate treatment in reducing this is characteristic, whereas it usually has very little effect in gonorrhœa.

(*b*) More joints are involved. The gonorrhœal case has one joint or at most two, in which the pain and other symptoms persist for weeks and remain stationary; minor degrees of inflammation in several other joints, or the neighbourhood of joints, *i.e.*, in tendon sheaths, bursæ and fasciæ, may be present besides; such an occurrence is most unusual in acute rheumatism. In the rheumatic case a second or third joint is involved, as the first subsides, &c., *i.e.*, the pain and symptoms fly about.

(*c*) The actual intensity of the rheumatic pain is probably greater, but is more transient than in gonorrhœa.

The close resemblance of some attacks of gonorrhœal arthritis to the acute polyarthritic varieties of osteo or rheumatoid arthritis in young women is such that they are indistinguishable, and it is highly probable

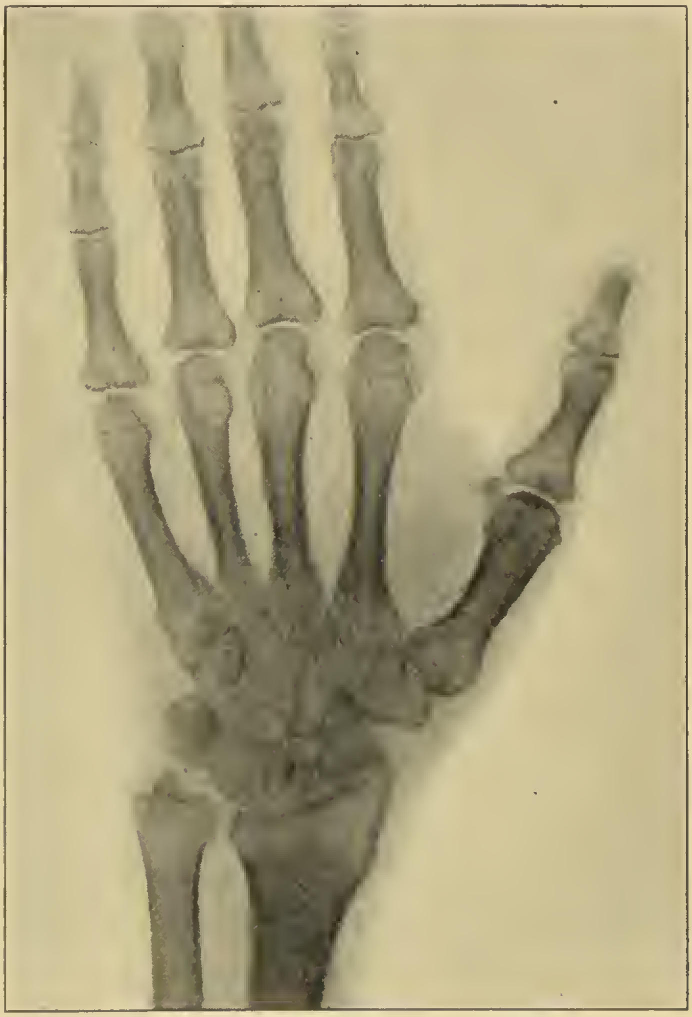

FIG. 32.—Gonorrhœa of wrist joint. The X-ray feature is the general blurring of the articulation, which is diagnostic to the skilled radiographer.

that the typical acute fibrosing rheumatoid arthritis in women is due to gonorrhœa, as it is almost impossible to exclude this infection in women. Even if it does not obviously exist in the vagina as a gross leucorrhœa, it may be present in the uterus and tubes. I have found a pyosalpinx of gonorrhœal origin in one case of rheumatoid arthritis in whom this infection had always been excluded *clinically*. She had severe fibrous ankylosis of the fingers, with trophic lesions of the skin.

The association of tender, spasmodically contracted *muscles* which are somewhat swollen, the skin covering them red and slightly inflamed, points to a myositis which is not infrequent in gonorrhœa. While modern pathologists attribute the so-called rheumatic iritis much more generally to the gonococcus than formerly.

Results.

(1) Complete recovery, though generally protracted.

(2) Ankylosis or dense fibrous adhesions, both intra- and peri-articular.

(3) Chronic effusion (hydrops) with flail joints.

(4) Suppuration and severe ankylosis, or subluxation.

(5) Some authors give a recurring form of *Hydrarthrosis* as a sequel of the acute form, the periodicity of the effusion being its most important characteristic.

(6) In the foot the disease is very prone to be followed by flat foot.

On account of the difficulty of curing posterior urethritis and the cowperitis, vesiculitis, &c., which often complicate the local condition of the urethra, *relapses* are common, and if they are severe crippling of the joint almost always results. In acute gonorrhœa affecting the *anterior* urethra only, the prognosis is much better than in posterior urethritis.

Treatment.

No arthritis responds more readily to relief of pain by Bier's congestion bandage, and in none does hot air help in the process of absorption to a more gratifying measure than in gonorrhœa.

It is the ideal acute arthritis for this kind of treatment, the details of which are given under Severe Synovitis and Arthritis.

It is stated that Bier's does not shorten the duration of the disease, but this depends upon many other factors.

In the "dry" condition, which means that the affection is chiefly limited to the fibrous tissue and the peri-articular structures, even in the acute stages the hot-air douche effects rapid relief of the severe stiffness and makes the structures supple very quickly after a few preceding days' use of the bandage *alone*.

What has already been stated as to EARLY active and passive movements is imperative in the dry form as well as in the varieties with effusion.

True suppuration is infrequent and is due to mixed infections; the "pus" is of a yellowish-green colour, thin in consistence with masses of œdematous-looking greenish or yellowish lymph floating in it. If secondary infection is severe the usual type of pus is seen.

As usually treated, there is a great tendency for the fluid to remain unabsorbed and the condition to become chronic. In these circumstances and when the intra-articular effusion is great (one must be certain it is intra-articular, see Symptoms (3), p. 180), aspiration under strict precautions will be advisable and may be accompanied by flushing with normal saline at the temperature of 100°.

I think if one does make any wound into a joint it is wiser to use a big aspirator through which the masses and flakes of lymph *can be drawn* (or even to make a small incision, which is then immediately closed), as these *masses* of lymph are only partially absorbed and remain to become partly organized into fibrous tissue and fibrin bodies, or produce adhesions.

Ionization of salicylates or lithium decidedly relieves pain ; it is generally carried out once daily for twenty minutes to one hour.

General Treatment.—The urethra or vagina must be treated vigorously. The *former* is treated at first by irrigation with weak potassium permanganate solutions, 1 in 5,000 twice daily, by a meatal, single or double-way nozzle. The vessel containing the solution is suspended at a height of 2 to 4 ft. The bladder is not entirely emptied previous to the irrigation.

At first the anterior urethra alone is washed out ; then, if the posterior urethra is involved, by obtaining a 4-ft. head and keeping the meatus firmly closed over the nozzle, the resistance of the peri-urethral muscles is overcome and the bladder filled with solution, which is then voided by voluntary effort, or a very weak solution of cocaine may be injected previous to irrigation, to render the compressor uræthræ inactive.

In a severe case 2 to 4 pints may be used, and if possible two to three times a day.

After seven days, or sooner in chronic stages, a VERY WEAK silver nitrate solution 1 in 15,000 or 10,000, is used every third or fourth day, unless it proves too irritating and greatly increases the discharge, which rapidly diminishes under the permanganate.

The latter is continued for two weeks or more after cessation of all obvious discharge or turbid urine, and when glueing of the urethra in the morning has disappeared.

A Herring's urethral syringe apparatus is absolutely safe for anterior urethral injections (Maw, Son and Sons).

Combined with this I give urotropine, helmitol, or the hexatetramethylene 2 gr., in water 1 oz., every hour during the day, and I *avoid* the intake of large quantities of liquid, so as to give the urethra rest.

In all male cases I first use a Bier's bandage or the suction glass on the penis.

The bandage is worn over a layer of soft chamois leather or lint and invariably encloses the scrotum ; it is worn ten to twenty hours, and œdema *must* be produced and the discharge of pus must *soon* be replaced by a mucous or serous effusion. Micturition is easily performed. The tension of the dorsal vein and œdema of the prepuce are the best guides.

The suction glass is used in some cases, but is not so convenient nor can it be used continuously, as may the bandage.

If irrigation is employed also, it is used once daily after ALL swelling and œdema has quite disappeared.

If the practitioner is unaccustomed to the bandage he had better rely upon irrigation.

Quinine in chronic cases is useful. In the very debilitated condition which some of these patients get into, if they have had several joints severely involved, the greatest care and attention is demanded and everything must be done to increase the general health.

The precautions generally followed after attacks of acute rheumatism are here also desirable. All kinds of drugs are used, but quinine has appeared to me of greatest use.

Torrey's anti-gonococcal serum and vaccines are very uncertain, even in the hands of their enthusiastic adherents ; personally, I have had no reason to believe in their efficacy. Nearly all authorities agree that only in the chronic stages is any good effected by antigonococcal serums and vaccines.

Tonics, general massage and the drugs usually given after prolonged illnesses, such as the syrup of iron, arsenic, and strychnine are recommended.

CHARCOT'S DISEASE, NEUROPATHIC ARTHRITIS, NERVOUS, SPINAL, &c., ARTHROPATHY.

THESE peculiar joint affections are found typically in cases of locomotor ataxia, but similar, though less pronounced, examples are seen in various diseases of the brain and spinal cord, sometimes in—

General paralysis of the insane.
Cerebral hæmorrhage.
Progressive muscular atrophy.
Acute myelitis and anterior poliomyelitis.
Tumours and injuries of the spinal cord.
Injuries to peripheral nerve trunks.

In *syringo-myelia* a similar condition is found, which has certain special peculiarities.

Usually seen in adults, it may occur in childhood; it has a predilection for the lower extremities. Usually a single large joint is affected, but it may be multiple and involve small joints.

The *knee* is involved more often than all other joints combined; after this the hip, foot, and ankle, shoulder, and elbow is the order of frequency.

Its relation to tabes dorsalis and general paralysis of the insane brings syphilis into question, but no amount of anti-syphilitic treatment is of any value in curing the RESULTS of the condition once established, although efficient mercurial inunction would in all probability prevent its onset by preventing the nervous lesions.

The *pathology* of the disease does not seem to me to be different in its *details* to osteo-arthritis, and except for the very excessive destruction which may take place, and the greater tendency to peri-articular inflammation (which is also characteristic of gout), I cannot satisfy myself that there is any difference between these conditions.

The *effusion* is usually marked, but, as in a large number of cases, there is much peri-articular œdema or effusion ; all the swelling does not exist in the joint.

Whether this œdema is due to escape of fluid from the joint by leakage, or is the ordinary collateral œdema, due to vaso-motor disturbance, is difficult to decide.

The fluid is generally turbid with flocculi of lymph, and it may be faintly blood-stained or brown from disintegrated blood. The distension of the synovial membrane and capsule is usually marked; the ligaments and capsule are stretched and thinned out, thus resulting in a flail joint.

The *cartilages* undergo liquefaction and absorption. Many writers state the cartilages undergo fibrous degeneration, and on account of the continual pressure are gradually destroyed (in short, degeneration and absorption), the bone sharing in this fate, and being replaced in the later stages by a low form of fibrous tissue infiltrated with calcareous salts.

It always appears to me that destruction is conduced to and repair ineffectual on account of the condition of the tissue and nerves.

Very little new granulation tissue forms, but any *pre-existing* fibrous tissue is peculiarly liable to calcification, and enormous stalactitic osteophytes therefore result; some are of remarkable shape due to partial involvement of ligaments and peri-synovial membrane (or even the ligamentum patellæ). Masses

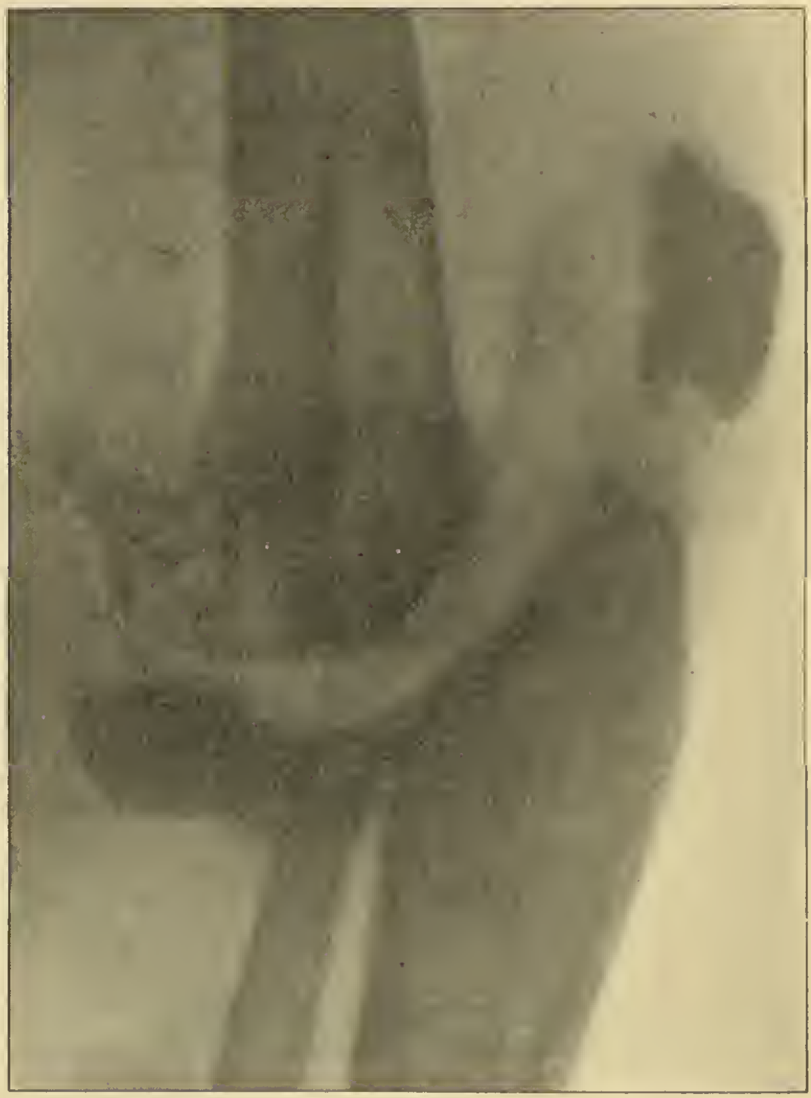

FIG. 33.—A CHARCOT'S KNEE. The irregular formation of masses of bone is well shown, the head of the fibula is expanded like a mushroom. The great absorption is indicated by the position of the patella and remains of the tibial tuberosities, also by the fact that the fibula now forms part of the "joint."

of calcified material thus form, which may become welded together or loosened into what remains of the joint cavity.

Hypertrophy of the margins of the articular cartilages occur with osteophytic formation.

The *bone* itself near the joint surface is more porous than normal, *i.e.*, a condition indistinguishable from caries sicca exists, and the articular extremities atrophy, *i.e.*, the trabeculæ are thinner, the spaces larger and filled with a fatty marrow, but the bony extremity as a whole is very frequently flattened out, as though it had once been plastic and distorted in shape while soft.

Subluxation is often present.

In the milder cases a much less degree of destruction takes place and the process ceases, leaving more or less evidence impossible to distinguish from osteo-arthritis.

In the *hip* and *shoulder* there is a greater tendency to the atrophic changes, while in the knee and elbow hyperplasia and osteophytic formations are marked—conditions, I think, which depend upon the attachment of lateral ligaments, &c., close to the articular surface.

Unfortunately—in one sense—the opportunity of examination of the joint tissues *during the acute stage or onset* is very infrequent, but the few cases so examined showed the typical inflammatory lesions seen in sub-acute septic arthritis (*i.e.*, osteo-rheumatoid arthritis), it is in fact impossible to differentiate the actual joint lesions.

An *epitome* by Roberts quite simply describes the conditions usually found in the chronic or late stages :—

(1) A chronic asthenic hyperæmia of the synovial membrane—a hydrarthrosis.

(2) An interstitial atrophy of the epiphyses.

(3) A fungous or rarefying epiphyseal hypertrophy.

(4) The formation of osteophytes and bony stalactites.

It affects both sexes about equally in proportion; 7 per cent. of all tabetics are liable to the disease, the onset of which is always early, and may precede the pronounced nervous phenomena.

The Symptoms.—The condition may have

(1) An acute
(2) Or chronic onset.

Usually the onset is sudden. In the majority there is no record of any form of injury, but not infrequently, following an injury or strain, a *comparatively* painless effusion into and about a joint occurs. Some cases are associated with a degree of pain, but this is out of proportion to the amount of swelling.

The pain when present is rather paroxysmal, although it may be constant, and is associated with definite tenderness on pressure, two symptoms which one would not expect in a typical case of Charcot's joint, and in the cases where the *joint alone* is examined it is impossible to distinguish between it and a very acute osteo-arthritis of septic or toxic origin. The pains are probably similar to lightning pains.

Occasionally the sudden distension of the joint is noticed because the patient falls down from "giving" of his limb.

The degree of the effusion into the joint may lead to disintegration, and even dislocation, within a day or two, unless the capsule gives and the fluid effuses into the surrounding areolar tissue.

The peri-articular swelling may give evidence of true œdema, *i.e.*, it may pit on pressure, and the skin may be redder and hotter than the opposite side, while in other cases it is firm and hard, white and shiny, and not infrequently almost the whole limb may be swollen. There is marked grating on movement, the shape of the bones rapidly changes, while abnormal movements readily appear.

The less rapid examples begin and run a more insidious course, and but for the associated *nerve* lesion would be called osteo-arthritis.

The *course* of the condition varies, and a rapid absorption of the fluid with a useful joint may result. Usually, however, destruction takes place, and a flail joint, with masses of loose bodies or stalactiform osteophytes, with or without dislocation, is the ultimate result.

The disintegration is partly due to stretching of the capsule and ligaments, partly to the marked absorption or destruction of the bone.

What is peculiar is the ability of the patients to get about on these flail joints, which they often do with remarkable facility.

Occasionally rupture of the skin has occurred, and discharge of the fluid ; these joints sooner or later becoming septic unless the sinus soon heals.

The condition of the muscles depends upon the nerve lesion, but atrophy and loss of normal response is the rule.

It appears to me that given *absence of pain*, as in tabes, a patient with osteo or rheumatoid arthritis would use *his* joints and get about on them, and from such unwise and excessive use and absence of rest, *he* would add largely to the damage done to the joint, and eventually produce the peculiarities now considered *distinctive* of "Charcot's joints," which are in truth the peculiarities of an ordinary osteo-arthritis exaggerated by want of the proper care, rest, and attention which a tabetic ignores because he has the misfortune not to feel pain.

At the same time it must be accepted that the nutrition of the tissues is impaired from loss of control of the vaso-motor system, a loss of the greatest moment in the physiology of inflammation and repair. These factors do not annul the identity of the underlying pathological basis, namely, that the disease is a toxic arthritis.

The DIAGNOSIS therefore must be made not on the joint condition alone, but from the associated lesion. If the nerve phenomena are not developed, the absence of spasm and limitation of movement, and the non-disturbance of the general health is chiefly to be relied upon, while positive dystrophic lesions should sufficiently indicate the name the condition should be called.

	CHARCOT'S	OSTEO-ARTHRITIS
Onset	Rapid	Slower
Number	One joint	Often many joints
Swelling	Very marked	Little effusion
Pain	Absent	Very marked
Epiphyses and deformity	Tends to atrophy	Tends to overgrowth
	Exaggerated osteophytes	Osteophytes small
Result	A flail joint	Tends to ankylose
General	Signs of tabes, especially the ocular symptoms	Invariably septic foci

Rose and Carless give the foregoing (somewhat modified) as distinguishing points between Charcot's and osteo-arthritis; but while this applies to typical instances, overlapping occurs, *i.e.*, there is a very acute type of osteo-arthritis, and a chronic Charcot's, also intermediate examples.

The *prognosis* is always bad; occasionally repair with a good joint follows spontaneous cessation of the disease; usually a more or less useless joint results.

Treatment.

The *General Treatment.*—Anything which may help to improve the nervous system should be done. Whether injections of strychnine, or mercurial inunction, or potassium iodide are indicated, depends upon the nature of the lesion. **All the Para-syphilitic lesions demand vigorous mercurial inunction.**

Electrical treatment may be of service. I am strongly convinced that the septic absorption—toxæmia—view, enunciated under Osteo-arthritis, enters into the pathology of this disease; therefore septic foci in the gastro-intestinal and genito-urinary tracts must be treated and thoroughly dealt with.

Locally—

It appears to me that the indications may be summed up in "prevent deformity."

If the *effusion is moderate*, absolute rest in bed with massage, firm wool elastic compression, with or without a splint.

If the *effusion is marked*, and therefore likely to result in a flail joint, *aspiration* repeated as required, or *incision and drainage* for two or three weeks until the tendency for collection of fluid ceases.

Then *absolute fixation in plaster-of-Paris*, or a strong water glass, or starch bandage, in order to enable the soft tissues to shorten again. After two or three months a suitable apparatus to support the joint and take off all the strain should be worn.

A well-made apparatus will probably have to be worn hereafter always.

It is highly inadvisable to operate, but *excision* has been carried out; but bony union is the exception, and it is found that while only one joint is gravely involved others are implicated to a lesser degree.

Amputation in foot and ankle cases has provided a stump for an apparatus of a more suitable kind for getting about with than the flail joint permits, and may be advisable if only the one joint is affected.

In **syringo-myelia** this peculiar arthropathy is more frequent, involving especially the joints of the upper limb, as one would expect from the site of the gliomatosis in the cervico-dorsal spinal cord, and as it affects males twice as often as females the majority of the patients are males over 30 years of age. About 20 per cent. of syringo-myelia patients are the subjects of an arthropathy; excessive or prolonged active use of the arm and hand conduces to the joint lesion.

Two forms occur, somewhat similar to those of tabes :—

(1) The atrophic.
(2) The hypertrophic.

But why two forms ? There must be factors other than simply the *nerve lesion* to produce *two* varieties.

In the *atrophic* variety the disappearance of bone closely resembles caries sicca; an extensive amount of bone may be absorbed entirely and often the articular surface is represented by a conical or spiculated bone, while the shafts of the bones may become so rarefied that not infrequently fractures occur.

The symptoms are usually not so acute as in tabes, while the history of injury is more frequent.

Spontaneous dislocations of the head of the humerus are not infrequent for a long time before the onset of the arthropathy.

Trophic lesions of skin and its integuments are generally present, while the symptoms of syringomyelia are usually advanced.

The COURSE of the affection is much slower than in tabes, and the condition of the joint is intermediate between osteo-arthritis and the joint of tabes. Sinus formation and sequestra are not infrequent, and may often be treated surgically without a general anæsthetic.

The treatment is as already stated for the joints of tabes.

HÆMOPHILIC JOINTS.

In hæmophilia hæmorrhage into joints takes place :—

(1) Following an injury often so insignificant that it is overlooked, or even after prolonged exercise.

(2) Spontaneously, not infrequently during sleep.

The *patients* are generally boys, rarely young adults. The history of the individual or his brothers may clearly point to hæmophilia, though not infrequently the joint lesion may *first* call attention to the disease.

The *knee joint* is most often involved, although the ankle, elbow, and shoulder are affected, the liability of the joint to trauma probably determines the frequency of the lesion.

Pathology.—Primarily this is hæmorrhage, both intra- and extra-articular, followed by changes in the joint.

In some recorded cases the effusion has been described as serous.

The mildest consequence may be fibrinous and slight fibroid adhesions of the synovial membrane.

After a severe attack, and more especially following repeated attacks, a typical osteo-arthritis is set up, the villi enlarge, the cartilage fibrillates and is eroded, the bones may atrophy and become rubbed down and eburnated, fibrinous loose bodies develop, while adhesion or even ankylosis of a dense fibrous nature may occur. If extra-articular bleeding has taken place, matting of tendons, effusions into bursæ with fibrous thickening of their walls, and a pseudo-tumour formation may result.

SYMPTOMS.—There is generally a *swelling* of the joint with little or no *pain*, although this may be considerable if the extravasation is large as a result of a moderately severe trauma; very slight disturbance of temperature and the general health.

The swelling increases to some extent, due to the synovitis set up, but rarely reaches a great degree unless the hæmorrhage itself is a severe one.

The *characteristics of the swelling* are that it outlines the synovial membrane imperfectly, it tends to assume a globular shape, betwixt and between the ordinary serous effusion of synovitis and the swelling due to pulpy granulation of tuberculosis.

It feels more dense than serous fluid, but gives perfect fluctuation, which after a few days becomes less perfect, and then a doughy feeling is felt at some part or parts of the joint, which changes in the character of the swelling depend upon coagulation taking place. It is slightly tender.

In a few days *subcutaneous* evidence appears in the form of ecchymosis, which is diagnostic in the *absence of direct injury to the part*, or of a serious sprain, the symptoms and history of which would indicate the lesion. There is some impairment of movement, generally due to mechanical interference by distension of the joint and not due to spasm of muscle and pain.

The synovitis set up is very mild.

The *course of the case* varies insomuch as the degree of arthritis set up is severe or mild, or the effusion takes a long time to absorb; or if repeated attacks occur, in which case crippling of the joint from adhesions and ankylosis may result, whereas a mild case may recover almost entirely.

The persistence of the doughy swelling often leads to a suspicion of tuberculosis, but a close examination of the joint ought to put one right, especially when ecchymosis is present. Also the marked and rapid atrophy, and the spasm of muscles found in tuberculosis is absent.

An X-ray will definitely decide against tuberculosis of bone, while the shadow due to blood is denser than that of tubercular granulation tissue.

One must examine and treat a hæmophilic joint very gently.

Treatment. — Absolute rest in bed, with a firm wool elastic compression bandage, and possibly for a few days a splint to prevent movements.

The immediate administration of 30 gr. of calcium lactate, and smaller subsequent doses. To promote absorption the wool compression alternately with a mild form of hot-air douche (see p. 46).

If there is a tendency to repeated hæmorrhages which the pressure and calcium lactate does not control, thyroid extract 1 to 5 gr. two or three times daily according to age (the patient must be kept in bed), rectal injections of anti-diphtheritic serum, horse serum or gelatine have been used. These may also be given by the mouth.

All forms of operative interference have hitherto been contra-indicated from fear of hæmorrhage, but when the amount of distension (hæmorrhage) is very large, if repeated and full doses of calcium lactate or anti-diphtheritic serum be given, aspiration may be undertaken, and either a hot solution of *sterile* gelatine, or 1 to 5 per cent. calcium lactate or strong hazeline used to irrigate the joint (adrenalin and pituitary solutions may also be used).

The *important indication* is to provide that the joint is kept in a position which will make the limb most serviceable should ankylosis occur.

Mild extension and fixative apparatus will effect this, even if some degree of deformity is already present.

Forcible measures must on no account be undertaken, as the result is bound to be further hæmorrhage. If, however, the position of the limb renders it useless, it may be necessary to break down the adhesions in spite of the hæmorrhage, and *then* to see a good position results. Preliminary dosage with calcium salts or injections of STERILE gelatine solutions or pituitary and adrenalin may permit of forcible movements without resulting hæmorrhage. Pressure is immediately reapplied and a fair dose of opium given.

When all danger of further hæmorrhage has passed and it is necessary to aid absorption, hot air douches, gentle massage and compression by the elastic wool bandage (see Sprains) are used.

Mild local irritants, ung. hydrarg. co., ung. potassii iodidi cum sapone, with or without strapping, may be advantageous.

The first attempts at using the limb must be cautiously carried out.

INTERNAL DERANGEMENT OF JOINTS.

Laceration and Displacement of the Semilunar Fibro-Cartilages of the Knee.

THIS condition is very frequently diagnosed when it does not really exist, as it is *simulated* by conditions in the joints which are the result of chronic arthritis, such as enlarged synovial fringes with or without cartilage bodies, some still adherent by stalks, others loosened by rupture of the stalks and forming free bodies ; also by portions of articular cartilage, or even bone, broken off into the joint.

I have seen cases in which this diagnosis was made in which the symptoms were due to osteophytic outgrowths, and others in which the condition was due to intermittent interference with the action of tendons by osteophytes, both under the origins of the gastrocnemii and beneath the tendons of the hamstring muscles.

One case was so crippled as to compel one to remove some of the outgrowths.

In some cases the fibro-cartilages are not displaced but are diseased, *i.e.*, softened and pulpy, or even laminated, as a result of prolonged or repeated attacks of synovitis, &c., in such periodical attacks of pain and exacerbations of local synovitis imitate the symptoms.

The condition is found occasionally in the temporo-maxillary articulation, and the joints at either end of the clavicle, but the joint usually involved is the knee.

Two fallacies long connected with the injury producing displaced semilunar fibro-cartilage in the knee must be disposed of :—

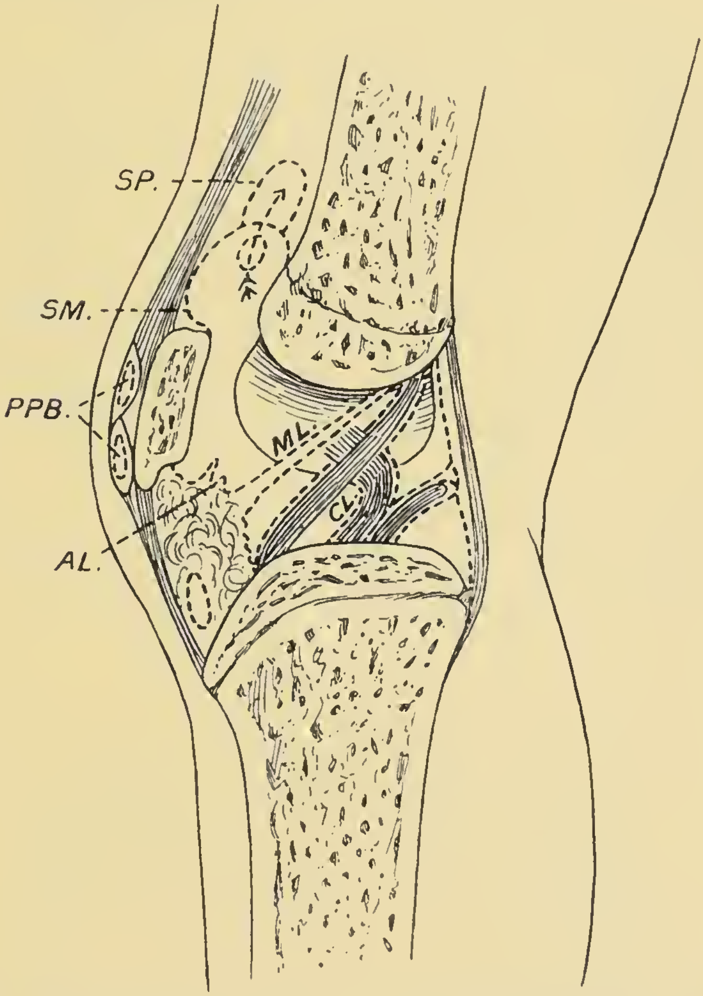

FIG. 34.—Section of knee joint. *SP*, Subcrureus pouch ; *SM*, synovial membrane ; *PPB*, prepatellar bursae ; *AL*, alar ligament, *i.e.*, the edge of synovial membrane spread over the subligament patellæ pad of fat ; *ML*, the mucous ligament : an extension of synovial membrane from the alar ligament to the intercondyloid notch ; *CL*, crucial ligaments.

(1) That owing to its firm attachment to the internal lateral ligament, the cartilage is PULLED OUT of the joint when severe strain is put on the internal lateral ligament in forced movements ;

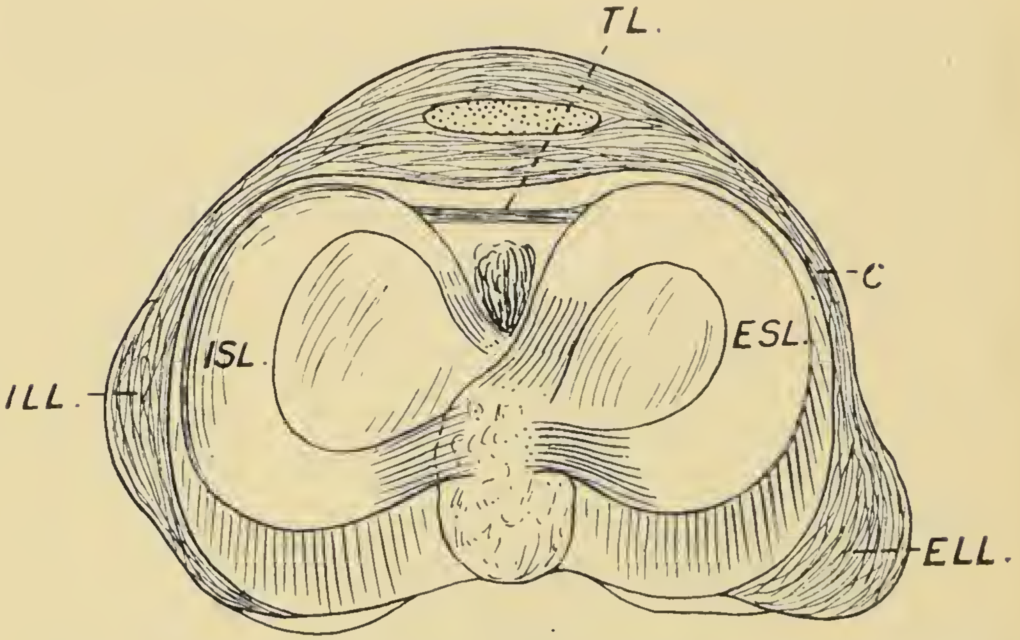

FIG. 35.—The semilunar fibro-cartilages *in situ*. *ISL*, Internal semilunar fibro-cartilage, note the thin anterior portion ; *ESL*, external semilunar fibro-cartilage ; *TL*, Tranverse ligament, frequently the sole attachment of the interna lsemilunar fibro-cartilage ; *ILL*, internal lateral ligament ; *ELL*, external lateral ligament ; *C*, capsule.

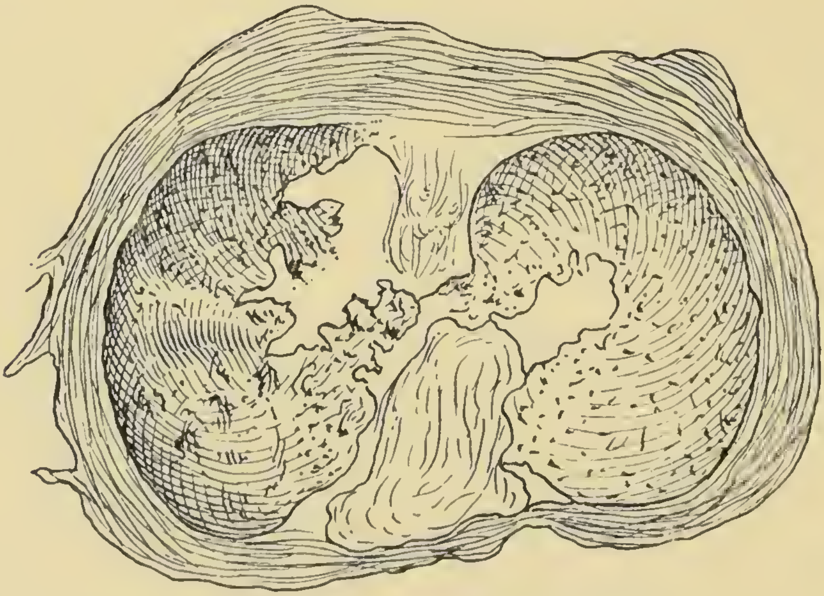

FIG. 36.—Shows a diseased pair of fibro-cartilages ; they are often laminated and irregularly thickened and distorted in toxic arthritis (see Osteo-arthritis).

(2) And that, therefore, it can be felt outside the joint in a large number of cases.

The exact manner in which the displacement is effected is not quite clear, but a consideration of all the factors indicates that laceration of the anterior attachment of the cartilage is due to direct pressure by the internal condyle of the femur, as if one put a stick against the cartilage and pushed or wrenched it off the surface of the tibia. Why and how the loosened anterior extremity curls up into the intercondylar notch of the femur is difficult to explain, except that following the laceration a recoil occurs, but that it is invariably found there is a fact.

Of recent years I have seen four cases of pseudo-internal derangement in boys of 12 to 14 years of age; these cases gradually developed sufficient creaking and roughness on movements *in other joints* as to clearly indicate they were suffering from early osteo-arthritis, and it appears to me highly probable that slight lipping of the femur may well explain how, in a forced movement, sufficient "hold" is obtained by the femur to effect rupture of the anterior and transverse ligament of the internal cartilage.

The *internal semilunar fibro-cartilage* is far more frequently displaced than the external, and this is not difficult to explain on anatomical grounds:—

(1) The attachment of the anterior horn of the internal fibro-cartilage to the articular surface of the tibia is by a much weaker band of fibrous tissue.

(2) Not infrequently its chief attachment is by the feeble transverse ligament, which usually supplements the foregoing.

(3) The anterior portion of the cartilage is much

thinner and narrower than any other part of either cartilage.

(4) The natural condition of the knee is towards a slight genuvalgum, and the chief strain during the movements which usually produce the injury is probably borne by the internal condyles.

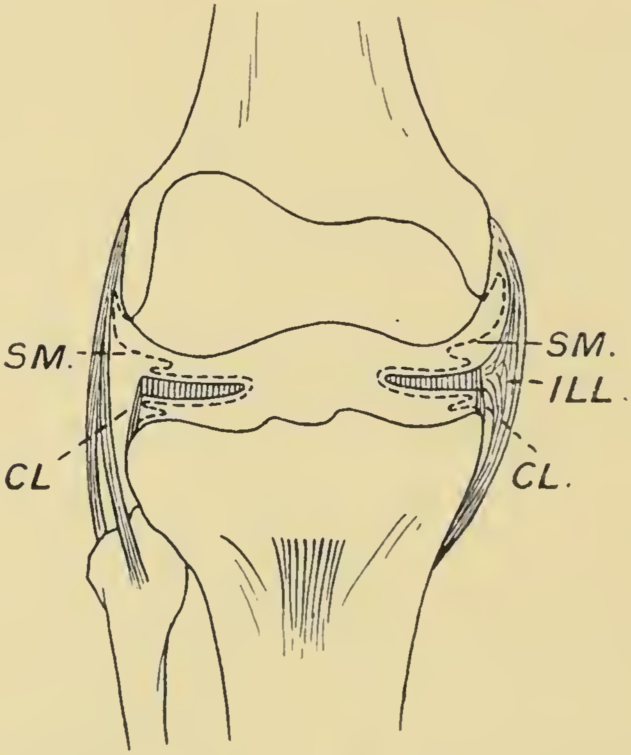

FIG. 37.—*The Fibro-Cartilages.* *SM.*, Synovial Membrane. *CL.*, the coronary ligaments, binding the fibro-cartilages to the articular margins of the tibia. *ILL.*, the internal lateral ligament, which is firmly attached to the INTERNAL semilunar fibro-cartilage, whereas the EXTERNAL semilunar fibro-cartilage is free from attachment to the external lateral ligament.

(5) When the joint returns from the flexed into the extended position, the tibia tends to rotate outwards (as may be seen, the foot tends to rotate outwards when the leg is straightened), so *if the foot is firmly fixed* on the ground when the knee is bent, and a violent straightening of the femur occurs, the internal

condyle of the femur rotates *inwards,* and so grinds the internal cartilage in a twisting or wrenching manner.

If any slight roughness of the cartilage itself or of the edge of the femur exists, this would readily permit of sufficient friction to enable the cartilaginous attachment to be torn.

(6) The fact that a portion of the periphery of the internal fibro-cartilage is firmly attached to the internal lateral ligament, which is put at great tension in the special movement concerned, and so fixes a considerable portion of the fibro-cartilage and permits of very little mobility, which otherwise might be sufficient to enable the cartilage to "give" under the rotatory movement, mobility being a most effective agent in averting injury. It probably also accounts for the recoil of the loosened anterior extremity.

After arthrotomy, undertaken for the cure of supposed internal derangement, not infrequently it has been stated that degeneration of the cartilage existed in these cases, and displacement did not exist; the anterior portion especially becomes laminated or cracked, and then flattened out. When this lamination exists, not infrequently a lamina becomes detached at one end and so plays freely in the joint, and occasionally gets nipped between the femur and tibia, so producing a special variety of internal derangement.

In some instances the anterior fibrous attachment is not *torn* but becomes *stretched*—occasionally the whole external edge is loosened or detached — the loosened anterior portion of the cartilage gets twisted lengthwise upon itself, somewhat in the form of an arch, and assumes a position between the intercondylar notch.

SIGNS AND SYMPTOMS.

The *history* indicates that during a violent effort the patient experiences a sudden pain in the knee; he may experience a sickly feeling, or great shock and faintness, and usually falls down. If he observes his position he says his knee was "bent under him."

The pain varies in degree but is always severe, and the *occasion is never forgotten.*

IN ALL CASES on attempting to straighten the knee he finds it impossible to do so COMPLETELY; generally he can flex it fully, although in some cases this also is possible only after a violent effort; in short, **the knee is locked.**

Sometimes spontaneously, or after repeated efforts at flexion and extension, he may succeed in unlocking it, and can then completely straighten the joint, and, except for a jarred feeling and lameness, he can walk with the *heel* firmly on the ground; otherwise he is able to walk *on the toes only*, with the knee slightly bent, and limps.

This history of a definite *severe* lock is of the highest importance, and is diagnostic of some hard substance having interposed between the two bony surfaces.

In the absence of this *severe* **locking, in contradistinction to just a "catch," one may legitimately question the diagnosis of locked cartilage, and in view of osteo-arthritis, make a thorough examination of the other joints for evidence of its existence.**

Occasionally a sound is heard or felt when the injury happens.

Within a short time synovitis always follows with—

(1) Swelling which assumes the shape of the synovial pouch. Occasionally some bruising appears.

(2) Continued pain.

(3) A sense of weakness in the joint.

If seen before effusion appears there may be nothing abnormal visible, but on *palpation* a point of considerable tenderness is found in the diagnostic triangle, *i.e.*, between the border of the patella *outside*, the tibia *below*, the margin of the femoral condyle *above and inside*.

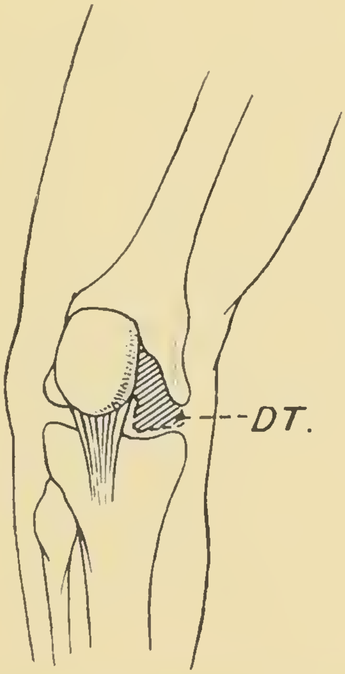

FIG. 38.—*D. T.*, Annandale's diagnostic triangle—the site of pain and tenderness soon after detachment of the anterior extremity of the internal semilunar fibro-cartilage, *i.e.*, internal derangement. Bounded *in front* by patella, *above* by articular surface of femur, *below* by margin of tibia.

In most other conditions of the knee-joint the tender spot is invariably about the attachment of the internal lateral ligament.

It happens in about 10 per cent. of the cases that the cartilage dislocates inwards towards the capsule, so-called "outside the joint," and may then be felt

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playing under the finger against the edge of the tibia, or, if seen later, it exists as a local swelling attached to the tibia. Generally, of course, it cannot be felt, as it lies inside the joint in the intercondylar notch.

The foot is slightly everted and, with the joint semi-flexed, an abnormal degree of lateral movement may be felt if the manœuvre is tolerated.

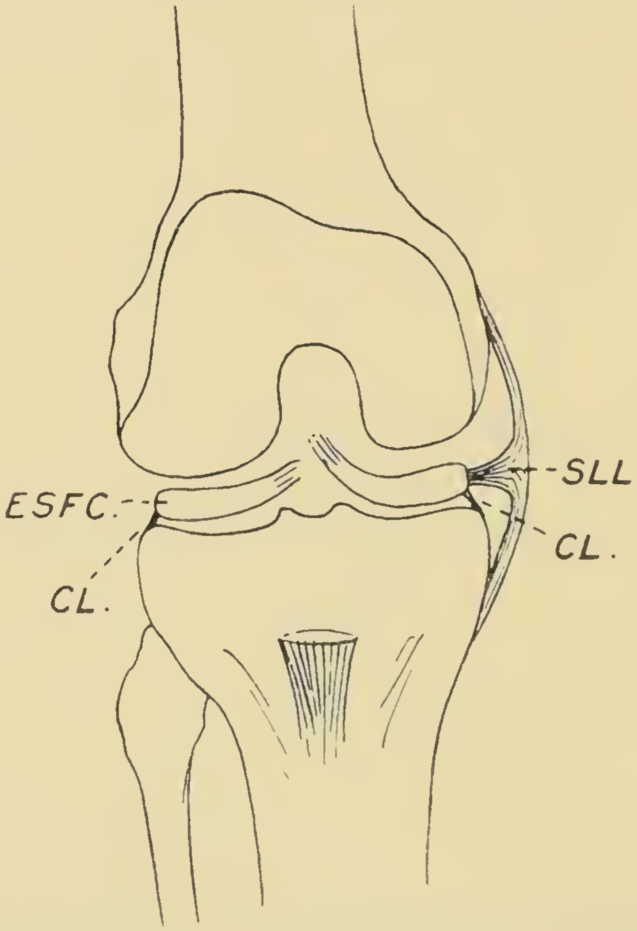

FIG. 39.—The semilunar fibro-cartilages with their ligaments in normal position. *C.L.*, coronary ligament.

The clinical picture soon becomes that of a traumatic synovitis (p. 34).

There is slight temperature and some disturbance of the general health.

TO RELEASE THE CARTILAGE.

If the patient is seen while the joint is still locked, an attempt is made to release the cartilage.

(1) This is done by laying the patient on his back on the floor, then kneeling at his damaged side.

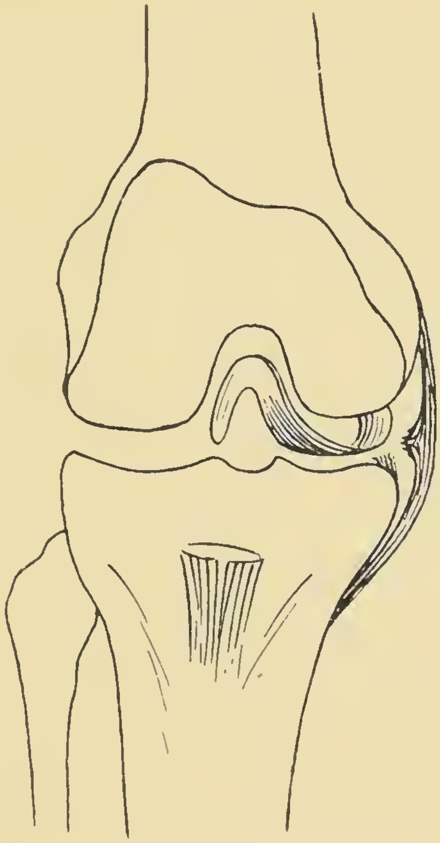

FIG. 40.—Diagrammatically shows the twisting of the internal semilunar fibro-cartilage and the position it takes up between the femoral condyles in 90 per cent. of cases. The torn ligaments are represented.

(2) Relax hip and knee muscles by fully flexing both.

(3) Now press your own knee against the outer side of his.

(4) Grasp the ankle or foot with one hand and the condyles of the femur with the other.

(5) Rotate the tibia, first inwards, then outwards, two or three times, while endeavouring to separate the

condyles by pulling the ankle towards you, as one breaks a piece of wood across the knee.

(6) Finally, while keeping up *inward* rotation straighten the limb.

A snap or click *may* be heard even when the cartilage is freed. The sole reliable proof of release is the ability to completely straighten the knee. The sense of relief experienced by the patient is very marked, but during anæsthesia this information cannot be obtained.

Reduction by performing the movements of the legs employed in swimming is stated by Whitelocke to be always effective. They may be carried out actually in a swimming bath or simulated by the patient in the supine or prone position on the floor.

If the reduction cannot be carried out while the patient is conscious a general or local anæsthetic invariably permits of success, otherwise operation is necessary.

If reduction without anæsthesia is not effected and favourable opportunities offer, rather than submit the patient to the discomforts of a general anæsthetic merely to dislodge the cartilage and then face the complications and damage to the joint following displaced cartilages, I would advise that an immediate removal of the loose portion of cartilage be carried out.

However, if the conditions are otherwise and it is, of course, necessary to dislodge the cartilage from the position in which it locks the joint, either a local anæsthetic be used (see p. 73), or a general one administered and the movements already described carried out. Then the synovitis and stretched ligaments are treated (see pp. 40, 91, Synovitis and Sprain).

Subsequent Course.

By prolonged rest *it is stated* that the displaced cartilage may become attached by adhesions and no further symptoms ever arise; this is most improbable. Generally, further symptoms do arise, it may be after a prolonged interval; usually locking of a *milder degree* takes place whenever the patient undertakes severe exercise or the knee is subjected to movements of a certain nature.

The cases in which recurring attacks occur are usually confounded with the *quasi-locking* by fringes, folds of synovial membrane, or other forms of floating bodies; or with the cases wherein the fibro-cartilages are soft, pulpy and laminated, and on slight synovitis occurring full extension movements produce pain, and a "catch" on sudden exertion.

In fact, in my experience, the recurring attacks of modified locking, without the history of an initial severe locking on a definite and unforgetable occasion, are cases of osteo-arthritis, in which the typical changes in the joints are present.

I believe the splitting and lamination of cartilage has, in a few cases, followed severe falls on the feet and accidents leading to hyperextension of the joint.

In all these recurring cases, both of true-locking and pseudo-locking (by fringes), the patients acquire a knack of disengaging the interposed bodies, generally by bending, then straightening the knee and giving the leg strong rotatory movement inwards by a sudden contraction of the thigh muscles.

The PROGNOSIS therefore of real rupture and dislocation of internal fibro-cartilages is bad in every respect, recurrence is the rule, disintegration of the joint, more or less severe, follows; even if no changes already exist in the articulation, they must arise from the repeated trauma and synovitis.

The joint becomes a source of worry, it is often flail and may exclude all exercises which entail considerable activity, and what is more serious may interfere with the occupation and livelihood of the patient.

My advice in these cases is, remove the cartilage at the earliest opportunity. Objection may be raised and the apparent cures—or rather absence of recurrence—quoted, but when these cases are fully investigated and especially if an expert X-ray examination is made, they are found to be of the quasi-locking variety due to osteo-arthritic changes, as true derangement of the fibro-cartilages invariably recurs.

When the **lower jaw** is involved intermittent interference with its movements in mastication occurs with pain and subsequent tenderness.

Later, partial subluxation from stretching of the ligaments occurs when the patient yawns or takes a large bite.

When the **sterno-clavicular articulation** is involved there is excessive mobility in the movements of the joint, with loss of strength in the arm, especially when carrying heavy weights, and attacks of pain and tenderness followed by slight synovitis occur from time to time.

The condition is brought about by violent efforts when the arm is abducted. The last case I saw was brought about in the effort to stop a runaway horse by seizing its bridle, the jerk caused rupture of the fibrous attachment binding the meniscus to the cartilage of the first rib.

Prolonged fixation, with straps and buckles, or strapping over the joint and binding the arm to the side may effect relief, otherwise operative interference is necessary.

Treatment.

As already stated, the immediate treatment is to dislodge the cartilage from between the bones. Even this statement is a relative one, as it is patent that if the anterior extremity of the cartilage is in the plane of the intercondylar notch and the posterior half of the cartilage is in its normal situation, the cartilage *must still cross the line of the joint.* What one really does is to dislodge it from its wedged position far back between the bones to a position more anterior.

When the limb can be straightened completely I advocate the use of a Bier's bandage to *try to* PREVENT severe reactionary inflammation taking place; in this way the effusion will probably be lessened and its coagulability diminished.

As Bier's bandage does not aid absorption directly, it is wise after it is worn for some six to twelve hours to remove it and apply gentle stroking (with elevation for a few hours), then either to reapply the Bier's or to apply the wool compression bandage over the joint, which should be removed twice in the twenty-four hours and gentle massage performed in the intervals. I think it answers well to alternate the Bier's with the wool compression bandage. In this way the effusion rapidly subsides, generally in seven to ten days.

It is advised that no movements of any kind be performed during a variable period of from seven to fourteen days to allow the cartilage to adhere and so obviate recurrence ; but this advice is founded on an erroneous impression, as the adhesions which form between the loosened cartilage and the bone are too feeble to retain it even if by good fortune it returned approximately to its normal situation. That this is so is known from the result of cases in which it has been *stitched* without effecting this object when once violent exertion was resumed ; also, it must be remembered that the cartilage itself is damaged by torsion and compression, so that some portion or another is thickened and may undergo further degenerative changes, which renders it very unlikely that the cartilage will remain attached when active exercise is resumed.

Consequently it is ill-advised, in my opinion, to keep the joint at absolute rest, and so permit adhesions *of the synovial folds*, which, however feeble, are always sensitive, and lead to painful movements.

Slow, gentle, and passive movements *should*, therefore, be performed daily, either when the Bier's is on, or during the intervals when the wool compression bandage is off, if the latter method is alone employed.

If the absorption of the effusion for any reason is slow, a more stimulating treatment may be carried out, and I think here, again, ionization with iodide of potassium or salicylates will be beneficial.

The alcohol compress worn for two hours now and again may start improvement.

Otherwise rubbing in ung. potass. iodidi c. sapone, or painting on spirituous solutions of iodine and mild blistering may be carried out, or strapping over Scott's dressing performed.

After seven days *active* movements are carried out, but as gentle rotation of the tibia as is possible is permitted; thus the action of *full extension* of the joint is not actively performed, nor is any lateral strain to be applied. Deep massage, carefully avoiding the diagnostic triangle, is now necessary.

As with all other joint cases, getting about must be begun cautiously; the patient may assume the vertical about the ninth to tenth day, and on the fourteenth may fairly safely walk, wearing a thinner layer of wool under the bandage; and if swelling tends to return readily the full elastic compress over wool must be worn when the patient again tries to walk—the knee being thus supported the patient cannot bend it beyond a few degrees and the full weight of the body is tolerated. If no trouble arises the soft flannel bandage without wool is worn for ten to fourteen days; a crêpe bandage is not quite so efficient, but may be used towards the end of the time. Remember that no bandage will prevent displacement of the cartilage. To strengthen the capsule and ligaments skilled massage and douching with hot and cold water alternately may be tried, and a useful mode of producing reaction, as well as effecting massage, is to direct a cold fine jet of water against the knee with as great force as the patient will permit.

In cases with intense effusion leeching or aspirating will be needed (see Synovitis, p. 72).

The operation for radical cure by excision is performed if possible when all evidence of synovitis is absent, and to ensure this complete rest for about a week is advisable. Any failure in asepsis may result in a catastrophe.

The main points are the following :—

(1) The knee, supported on a sandbag, lies slightly flexed on its outer side.

(2) The incision through skin and subcutaneous tissue may be vertical, curved inwards, or downwards, the length about 2 in. ; and one-third of this lies below the cleft of the knee, which may fairly accurately be said to be level with the pointed lower end of the patella when the leg is fully extended.

(3) The fascia and capsule extending from the side of the patella is exposed and incised vertically; if for any reason it must be enlarged it is converted into a T by a horizontal cut towards the lateral ligament, but this is not usually required.

(4) Perfect *hæmostasis* is secured.

(5) THEN the synovial membrane is opened and the wound retracted as widely as may be necessary to see the displaced cartilage ; if it is not at first visible the knee must be flexed and extended a few times, while the cartilage is carefully sought for.

(6) Grasp this with an artery forceps, and pull the loose portion into the wound ; flex the knee more fully and with a *probe-pointed bistoury* cut the cartilage obliquely behind the obviously free and damaged part.

(7) Make no attempt to remove the *whole* cartilage ; do not insert a finger or any foreign body into the joint other than the Spencer Wells or other forceps used to grasp the cartilage, and the knife.

See that the bistoury does not damage the articular cartilage.

It is advised to palpate with the gloved finger, or to fill the joint with saline and look for floating fringes, &c., or to make other investigation into the condition of the external fibro-cartilage, &c.; if there is found a recently displaced fibro-cartilage my advice is, DON'T. If the arthrotomy is a speculative one, *i.e.*, the diagnosis is in doubt, or the case is of old standing and complicated by osteo-arthritis, &c., then matters assume a different aspect, and a thorough examination is advisable (see Osteo-arthritis, p. 116).

After-Treatment.—It is unnecessary to drain the joint unless bleeding has occurred, as the damage done is infinitesimal. I prefer to so sew the synovial membrane that a gap exists, through which any effusion may escape. If a drain is necessary, a fine tube just penetrating the joint is best (removed in twenty-four hours). Put on a sterile dressing with plenty of wool and a firm bandage, and lay the limb on a pillow.

Remove the wool and bandage within four days, and gently move the joint for 20 to 30 degrees, and then redress it. Repeat on the seventh or eighth day and remove the stitch. I always use the subcuticular continuous stitch, as it is painless and far less likely to result in skin sepsis.

After this the bandage is removed daily, and *active* movements with gentle massage by stroking carried out.

After ten days the patient may begin to get about with the wool compression bandage on, and after fourteen days the latter may be discontinued and douching (see *ante*), and massage continued another seven to ten days.

Violent efforts should not be attempted till some six weeks or so.

Chronic cases take a longer after-treatment. In these I use Bier's congestion bandage and hot-air baths and douches.

NOTE.—Except in rare instances a knee-joint should invariably be put up slightly flexed; if fully extended the position becomes very irksome.

The most damaging of all adhesions is that of the patella to the femur; this bone should always be gently moved from side to side to ensure it does not adhere to the femur.

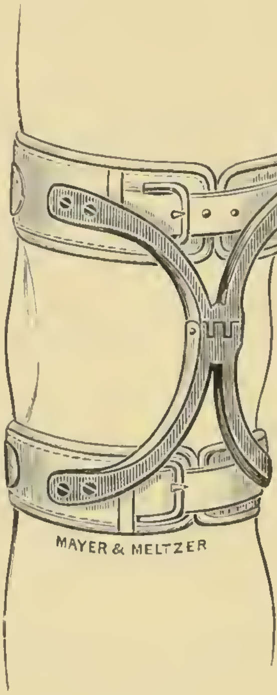

FIG. 41.—A form of apparatus with a posterior hinge to prevent rotation of the femur and tibia. More convenient to wear than the one with lateral irons.

If patients object to operation, or are the subjects of diabetes or severe Bright's, or grave heart lesions, an apparatus which will prevent rotation of the tibia and femur is the only mode of treatment available.

No apparatus will with certainty prevent displacement; probably their real value lies in preventing active exercises and in reminding patients of their disability. No known apparatus will do any good in which a patient may, for instance, play football.

The apparatus designed to effect pressure over the position of the cartilage and prevent its displacement is useless for this purpose, probably in all cases—certainly in the 90 per cent. in which the cartilage is displaced INTO the joint it is simply a farce.

With modern methods of anæsthesia, practically all patients can be cured by operation ; the few who are unsuitable must reconcile themselves to a steady-going existence, though occasionally a slip or jar even under these circumstances results in a recurrence of the trouble.

The best apparatus consists of two strong, broad iron hoops covered with leather which buckle firmly, one on the thigh, just above the condyles, and the other on the leg just below the condyles of the tibia, with two *lateral* hinged irons (or a dorsal iron) permitting flexion and extension.

Patients invariably give up using them after a time, but they should be worn for at least twelve months. Patients should endeavour to walk with the toes turned inwards. The *inner* side of the sole of the boot should be thickened about a quarter of an inch.

SYPHILITIC DISEASE OF JOINTS.

My personal experience of *true* syphilitic lesions of joints is that they are rare in acquired syphilis in comparison with the prevalence of the disease, while they are much more frequent in the inherited form.

That joint lesions occur frequently in acquired syphilis I readily admit, but except in badly neglected and untreated cases of the disease, they are most often due to toxic absorption (or infection), from septic lesions (gastro-intestinal or genito-urinary chiefly)—*i.e.*, septic or toxic joints *in* syphilitic patients.

The very fact of contracting active syphilis not only adds greatly to the work of the body, but in all probability increases the virulence of the pre-existing septic lesions, situated as these are in the gastro-intestinal and lower genito-urinary systems, and so the development of the syphilitic manifestations often coincides with joint symptoms, really due to septic infection.

What I wish to convey is that the vast number of joint affections *attributed* to syphilis are toxic septic joints *in* syphilitic cases.

The intractable nature of these is due to the absence of treatment directed to the true cause—*i.e.*, to the septic factor.

The classification of syphilitic joints presents some difficulties.

The two following embrace all the manifestations.

(*Mr. D'Arcy Power's* in "*System of Syphilis,*" *vol. ii., p.* 44.) It is given therein "for the sake of convenience."

Secondary	Arthralgia	
	Synovitis	Intermittent Chronic
Tertiary ...	...	Gummatous. Chondro-arthritis. Charcot's joints (see special chapter).
Inherited ...	...	Suppurative arthritis. Hydarthrosis. Symmetrical serous synovitis (Clutton's disease). Gummatous synovitis Chondro - arthritis, ulcerating or von Gies' joints.

THE SECOND CLASSIFICATION.

Primary Synovial.

(1) Arthralgia.

(2) A chronic effusion with little or no infiltration of the membrane.

(3) Definite syphilitic infiltration.

  (*a*) Diffuse in distribution.

  (*b*) Local or gummatous.

Primary cartilaginous chondro-arthritis.

Primary osseous (in inherited syphilis).

(1) The suppurative arthritis due to epiphysitis.

(2) Symmetrical serous synovitis of Clutton.

The **pathology** of the disease is simply that of inflammation, the characteristics of this type being the marked tendency of the toxins to excite proliferation of the fibroblast producing structures (see p. 17).

Hence there is always a well-developed proliferation of the lining endothelium of blood-vessels, resulting in endarteritis, with occasional complete obliteration of the lumen.

Similarly the round-cell exudation consists of a large proportion of fibroblasts, which revert to fibrous tissue when the process subsides and heals, hence dense scar tissue with thickening and puckering results.

The granulation tissue and round-cell exudation tend to undergo a form of caseation or fatty degeneration, partly from the destructive action of the toxins and partly from deficient blood supply owing to the contraction or obliteration of the lumen of the blood-vessels.

This fatty degeneration is always associated with scar tissue formation, the dense bands of fibrous tissue running through or circumscribing the degenerated area, which is in marked opposition to the caseation of tuberculosis.

Just as a tuberculous or any other inflammation may progress into and through the capsule, into the subcutaneous tissue and skin, finally rupturing through the integument, so will syphilis extend. The skin tends to resist the spread from below considerably and often large areas of bluish unhealthy-looking skin are seen for some time before the centre of the area ruptures or disappears, to leave an orifice at the bottom of which is a dense, tough greyish-yellow slough still firmly adherent to the deep parts.

This slough gradually comes away as discharge, or when loosened by suppuration at its attachment to the healthy tissue it may be removed *en masse*, generally leaving a cavity or sinus of varying depth.

These sinuses are liable to septic infection and the arthritis may be converted into a septic arthritis.

When the disease begins definitely as a bone or periosteal lesion there is always marked thickening of the end of the bone, or a nodular formation of a more localized nature called a node.

If it begins as an epiphysitis in a young person, there is a great tendency not only to involve the joint as in any other form of infection (see p. 245), but also to separation of the epiphysis from the diaphysis or shaft, a condition which complicates the treatment.

In older patients thickening of the *shaft* of bones, *i.e.*, on the diaphysial side of the epiphysial line, is strongly suggestive of syphilis, when associated with an indolent synovitis.

The *effusion* is generally of a serous nature, clear, except for some flocculi in the early stages, with very little capacity for spontaneous coagulation.

Arthralgia generally occurs quite early in syphilis, often during the stage of primary infection, when a *pain* of an indefinable aching, gnawing character arises ; this may be situated in a joint or joints or in the region of a joint ; sometimes it can be localized to a definite area and may then be increased by pressure or muscular activity, at other times it is more diffuse and even referred, *i.e.*, neuralgic in character.

It is worse at night or in the early morning, a peculiarity not confined to syphilitic joints, but rather more constant in them than other chronic infective or toxic joints.

The " bone " pains, *i.e.*, an aching, tender, bruised or gnawing feeling in all the subcutaneous bones, and often in fleshy parts, especially felt when in bed at night, is a frequent symptom at this time, and as there is generally some rise of temperature, a diagnosis of subacute rheumatism may be made.

The result of salicylate treatment is negative, however, and in a short time the diagnosis is settled by the onset of cutaneous and mucous membrane lesions.

There can be little doubt that the affection is due to toxæmia similar to any other toxic joint arising in the course of an infection, but modified by the slighter virulence of the toxic process in syphilis.

Whether hyperæmia of the synovial membrane exists is uncertain, as *on examination* the local condition presents none or but slight manifestations, *i.e.*, a slight puffiness of the joint may exist; it is hardly likely, therefore, to be mistaken for a gonorrhœal joint by any one of experience, although the presence of gonorrhœa and absence of secondary symptoms, at this early stage of syphilis, make a diagnosis of gonorrhœal arthritis seem highly probable. There is, however, invariably present the hard sore, and at least local lymphadenitis of the specific character, which in the absence of the intense pain and marked limitation of movement in a joint actually infected by the gonococci should lead to a diagnosis of syphilis, even without a Wassermann's test.

It is fair to assume that the presence of gonorrhœa is likely to add to its intensity, but the arthralgia is often present without gonorrhœa.

The very mildest treatment with mercury invariably acts as markedly as salicylates in acute rheumatism.

The Synovitis of Syphilis.—Although I have given the classification of Mr. D'arcy Power, it is difficult to describe joint syphilis as most usually met with, as clearly thereby as under the second simpler one.

The usual form of synovitis is a chronic *comparatively* painless form, but Mr. Power's classification rightly impresses upon a form in which there is an acute rapid effusion into a large joint with considerable pain, but the pain is not increased on movement.

There is a considerable peri-articular effusion affecting the bursæ, tendon sheaths, &c., so obscuring the shape of the joint, but the movements of the joint are nevertheless smooth. The effusion may disappear equally suddenly perhaps to appear in another joint.

The usual chronic form is not infrequently ushered in somewhat in the acute mode above described, but I must state my belief that these acute forms are most frequently seen in patients the subjects of mixed septic infections as well as syphilis, and I think the type of case should be differentiated.

Its *onset* may be preceded by indefinite fleeting pains, with a sense of stiffness, and some tenderness of the bones forming the joint. It is most common in women.

The *knee* is far more frequently involved than any other joint, and it may be bilateral, but is not invariably so. Then a fluid *swelling* of a painless character occurs; its amount ranges from very slight quantities to a large hydrarthrosis, but it never appears as a tense distension; the joint cavity gives the impression that it could hold more.

In this form of the affection, very little or no thickening of the synovial membrane and none of the bones exists.

It has a *tendency to vary*, often within twenty-four hours; thus it may almost disappear one day and recur to a pronounced degree the next day or so.

Its comparative painlessness when truly of syphilitic nature is a peculiarity of importance in diagnosis.

The *movements* of the joint are only interfered with mechanically by the presence of the fluid, and the patients use the limbs with apparent unconcern. There is little or no spasm and very little *early* atrophy of muscles.

There is little or no evidence of redness, heat or tenderness. In neglected or intractable cases lateral movements, grating or creaking or movable bodies may be felt, and atrophy of the muscles occurs. Or on the other hand, if there has been considerable contraction of the capsule, ligaments and peri-articular structures, fibrous ankylosis may restrict the movements of the joint.

Occasionally the condition remains intractable in spite of correct mercurial treatment; this I maintain is due to the associated septic infections upon which naturally the mercury (and iodide) has no effect—rather a prejudicial action, and the correct treatment is to deal with the septic foci.

When the Disease is a Diffuse Synovial Infiltration.

There is in addition a *considerable degree of thickening of the membrane* which stands up prominently and can readily be rolled under the thumb; this thickening is firmer, more definite than that due to tubercle (which is more doughy) and is not so much IN the joint as in its parietes, a differentiation fairly easily made, as there is more marked effusion in syphilis as a rule, and the examination can be more effectively carried out, being painless. Also the amount of swelling is greater and less uniform in its outline than that due to tuberculosis.

The movements are somewhat restricted, but *comparatively* painless, while the patient uses the joint freely, which is far from being the case in tuberculosis. The reflex spasm and atrophy of muscles is absent in syphilis, present in tubercle to a marked degree. While in even the most chronic cases the posterior displacement with flexion and external rotation of the tibia is absent and the limb can invariably be fully extended.

If the membrane is involved by the gummatous variety, or, as it used to be called, tertiary syphilis, then the *localized indolent*, i.e., *practically painless nodules* of granulomatous formation may be easily felt, they may be of great thickness and hardness, and can be grasped between the fingers. They are best felt in the subcrural pouch when the knee is involved and bursæ are not infrequently affected when situated in the region of the involved joint. The amount of effusion varies, generally it is moderate in degree. They not infrequently are either associated with gummata of the skin and subcutaneous tissue, *or extend and involve it*, when, in the early stages, the hardness with little pain and slight heat characteristic of gummata can be felt, followed later by softening in the centre, blueness of the skin and evident breaking down, which although more painful than at first, is devoid of the intense heat, pain and throbbing of a pyogenic abscess. The absence of *general symptoms* also belies a pyogenic infection.

As before stated, these gummata may lead to pyogenic infection of the joint if they break through the skin and aseptic dressing is neglected.

When **the syphilitic deposit begins in bone** its behaviour resembles that of tuberculosis, as described on p. 245.

It may destroy the cartilage and infect the joint cavity suddenly, giving rise to an acute synovitis of a not very virulent form.

Or it may extend to the attachment of the capsule and synovial membrane, and give rise to a local infection of these, which may then infect the joint, or the disease may become manifest as a gummatous or diffuse synovial infection.

Let it be clearly understood that the most important factor in the diagnosis of Joint Syphilis is the diagnosis of active *syphilis in the patient, or a history of such and of its inefficient treatment.*

In **inherited syphilis** certain additional facts are observed :—

There are two varieties of synovitis
1. Symmetrical serous synovitis.
2. Gummatous synovitis.

In the *synovitis* first described by Clutton, after whom it is called, the condition is *symmetrical* and affects the knees, shoulders, ankles and wrists, generally before puberty.

The joints are full of fluid, but are neither tense, painful nor limited with regard to movement. The effusion in some cases may be excessive and classed as hydrops articuli. There is no evidence of inflammation in the skin, and although no joint effusion occurs without some increase of heat, this is not distinguishable to the examining hand. There is no spasm or noticeable wasting of muscles.

The diagnosis is made chiefly on the existence of other signs of congenital syphilis, otherwise the pathological condition is that of a diffuse gummatous synovitis. The membrane is largely converted into a thickened, villous, gelatinous membrane, with excess of blood-vessels, which gives it a pinkish colour except where caseation has occurred. It resists treatment in some cases to an extraordinary degree, but usually clears up and leaves an intact joint.

The condition known as Still's disease is largely simulated by this syphilitic arthritis (see p. 164).

In the **gummatous variety** which may affect several joints there is nothing peculiar to mention; the condition may be mistaken for a chronic tuberculosis, but has nothing in common with it really. Look for *associated* symptoms and signs.

Chondro arthritis is the most rare syphilitic affection of joints and is almost invariably found in *inherited* syphilis in both children and adults.

The *cartilage* is *supposed* to be primarily infected, then the bones. The synovial membrane is *always* infected. The cartilages are either pitted or laminated *horizontally* and worn to a mere membrane and finally eroded, the erosions being of a serpiginous outline or rounded, clean cut, punched out, and not corresponding of necessity with the points of greatest friction ; or the cartilage becomes puckered and scarred or grooved in a most characteristic manner, the pits occasionally containing caseous débris, the remains of gummata.

The exposed bone is slightly eburnated, while gummatous thickening with villous fringes and outgrowths of the synovial membrane develop, but *cartilage bodies are not* formed, nor is there lipping of the margins of the bone to the degree seen in osteo-arthritis. Thus while it resembles osteo-arthritis its pathology is different, being probably due to primary gummatous degeneration of the cartilage.

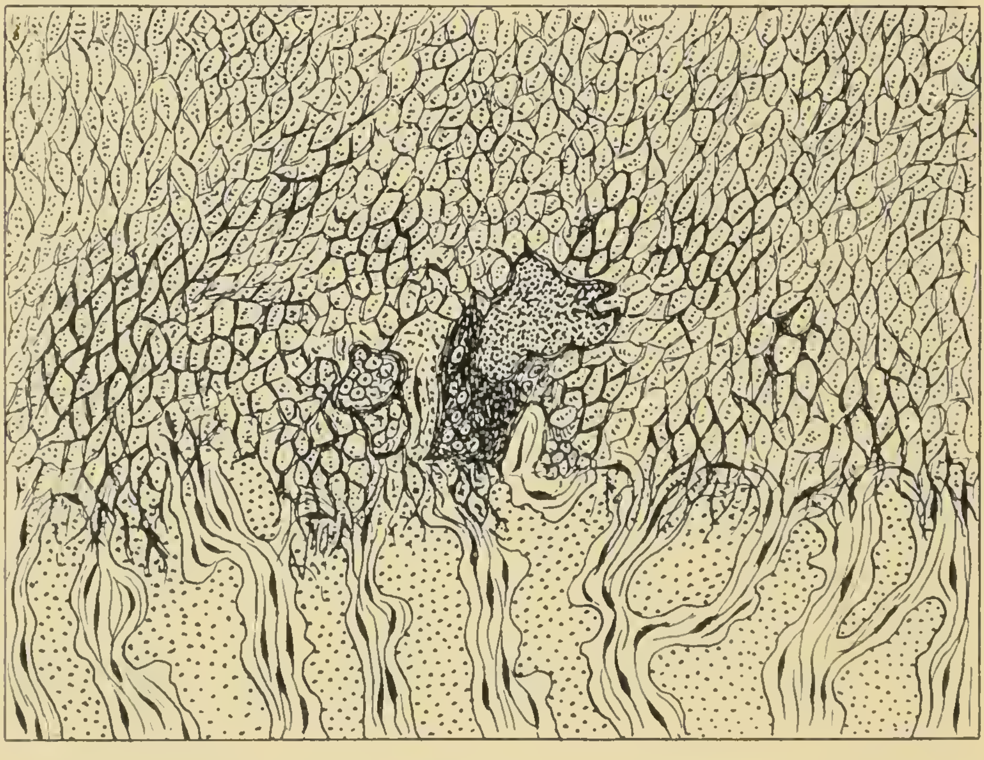

FIG. 42.—After Schmaus. Syphilitic osteo-chondritis; showing the irregular calcification.

The **acute suppurative arthritis** associated with *syphilitic epiphysitis* usually arises within the first year, often within a few weeks of birth.

It results in the rapid formation of an abscess in the joint and adjacent bursæ.

It generally affects the *knee,* which shows all the characteristics of an acute arthritis. Not infrequently in these cases septic conditions in connection with the umbilicus are present. If, however, the joint is freely incised and drained the condition subsides in a remarkable manner and if the epiphysitis is appropriately treated complete restoration of the joint function occurs.

Treatment.

In every case the chief treatment lies in administering a suitable mercurial treatment.

Inunction of ung. hydrargyri is by far the best method of treating the cases in *all* the stages, as it gets the patients under the influence of mercury quicker than any other method, not even excepting injection.

For children it is the ideal method, from 20 to 30 gr. of the ointment should be well rubbed into the flank or groin by the patient's mother every night.

The skin is first washed with soap and water, then dried carefully and lightly swabbed with spr. vini. meth. or sal volatile, a portion of the ointment is smeared on the selected part of the skin and thoroughly rubbed in until it *has disappeared,* then the remainder is treated in the same way.

From twenty minutes to half an hour may be necessary to thoroughly carry out the inunction. A flannel undergarment or a bandage is applied round the body.

In the morning the excess of ointment is washed off, *but the binder or vest is still worn.*

The following night the opposite side of the abdomen or groin is selected and the process repeated.

The same garment is worn for two or three weeks. With this object it is wise to use a flannel binder or a so-called cholera belt in preference to an undervest, as the latter becomes very foul under the armpits.

In the *case of adults* the treatment should at least be *begun* by inunction, ʒi being the dose most suitable to use.

If this is found irksome after the acuter symptoms have disappeared the treatment by *metallic* mercury given by mouth may be resorted to, pil. hydrarg. or pil. hydrarg. *c.* creta, gr. i, three to six times a day, or gr. ii three times a day may be given; but it is far less effective.

If the gastro-intestinal tract is free from sepsis, mercury is tolerated in large doses without any ill-effects and it is quite unnecessary to combine opium with it.

Metallic mercury, not the salts of mercury, should always be given for syphilis. Remember that if pills are ordered they should be recently made and the patient ought to be able to easily squash them; if this precaution is not attended to and the pills are too hard (especially if coated), they may pass through the body unabsorbed and the joint affection will not improve.

It is always wise to employ occasional periods of inunction in all cases of syphilis and at all stages of the disease if oral treatment is adopted.

In Synovitis if the *joints* are not improving under mercury and there is no septic focus to explain this, then iodide of potassium in large doses may be given, ʒss to ʒiii in the twenty-four hours.

Combine with this:—Local Treatment.

(*a*) Strapping over Scott's dressing.
(*b*) Firm pressure by wool elastic compression.
(*c*) Ionization of iodine in iodide of potassium.

In the still more chronic cases, aspiration followed by pressure, or arthrotomy and drainage under strict aseptic conditions.

The joints should always be well supported by means of large wool compression bandages or by retentive apparatus worn when the patient gets about. Strapping to some degree acts in both ways.

In the *gummatous* forms iodide of potassium should be given for some time as well as mercury. It is often overlooked that these cases require to be treated *generally* on the same lines as tuberculous cases, with plenty of nutritious food, open-air life, moderate degrees of stimulation; while in poor patients a rest from work and worries and a change to the seaside may help the treatment greatly.

I do not think the treatment of syphilis by atoxyl and other forms of arsenic should be lightly entered upon by the practitioner, and if the joint lesions are hanging fire it will be wiser to obtain the co-operation of another medical man before commencing this treatment, and to make it clear to the patient or his parents that a definite risk of partial blindness may be run by the patient even after a few doses of certain forms of arsenic. This danger does not appear to result from "606."

The method of treatment by injections has no advantage over inunction, while it has several disadvantages in private practice.

The sequelæ of syphilitic joints in the form of relaxed ligaments and flail joints, or the reverse condition of sclerosis of a peri-articular nature, must be treated on general principles.

The result of the treatment of Syphilis by "606," especially of the congenital variety, is so astoundingly successful that it is highly probable, when the drug can be obtained commercially, a revolution will be effected in the prognosis and treatment of Syphilis and Syphilitic Joints.

TUBERCULOSIS OF JOINTS.

TUBERCULOSIS may begin in either the bone or the synovial membrane.

It may spread to the joint from a tuberculous bursa or tendon sheaths or from tuberculous periostitis.

While it is undoubted that the tuberculous process may begin primarily (as far as the joint is concerned) in the synovial membrane, more accurate methods of examination, both clinically and at operation, clearly indicate with increasing certainty that the bone is far more frequently diseased than was hitherto recognized.

Formerly it was stated the synovial form was the *usual* mode of onset in childhood; now it is known that tuberculous epiphysitis is, at least, equally frequent primarily, and extension to the periosteum and synovial membrane occurs secondarily, and then increases rapidly and produces marked symptoms. When we remember that in the extremities of bones arteries corresponding to end-arteries exist, and that the blood-vessels in the cancellous tissue have sluggish circulation, thin walls, and diminished contractility, conditions which eminently favour the deposit of bacteria on the vessel wall, and so facilitate their escape into the peri-vascular lymph spaces, we are naturally led to attach increasing importance to the bones in the pathology of joint tuberculosis.

It should be unnecessary to emphasize the fact that there is invariably a nidus of tuberculous disease in some part of the patient's body, a gland in the thorax, neck or abdomen or a tuberculous otitis media, for example.

But it is now well established that tubercle bacilli, like any other form of bacterium, do pass through intact mucosa, or ultra-microscopically damaged mucosa.

Under both conditions the blood-stream is infected—a modified septicæmia (*i.e.*, bacteriæmia) exists.

It is but necessary to produce a suitably damaged part, and for the tubercle bacilli to gain access thereto, for a localized tuberculosis to be initiated.

In all cases, therefore, *either*—

The general resistance of the body is depressed by various undetermined conditions, or by preceding disease and defective hygiene, &c. Under such conditions, wherever sufficiently numerous tubercle bacilli lodge, localized disease is likely to be set on foot; so that it is well known a tuberculous process may start simultaneously in several joints.

Or localized areas of lowered resistance are established—

(*a*) By definite lesions, such as *slips*, leading to strains and sprains or slight hæmorrhages.

(*b*) *Blows, falls, wrenches*, which fracture a few bony trabeculæ, or partially separate an epiphysis.

(*c*) Or, again, for a fold of synovial membrane to be nipped and bruised, or the periosteum damaged; under any of these circumstances, the tubercle bacilli, if present in the blood-stream *at the time* of the accident, find themselves in a suitable medium and surroundings, and thrive—*i.e.*, proliferate—to give rise in a varying length of time to symptoms.

This seems to me the ordinary course of events, but as it takes an appreciable interval to effect repair of the damage, and so a return to normal, the bacilli *may* reach the injured part at a subsequent date.

This mode of onset of the disease is therefore *insidious.*

Occasionally a lymphatic gland or other tissue charged with active bacilli ruptures, and a more serious bacteriæmia is set up, or a vessel wall is involved by the tuberculous process; in either case a considerable number of bacilli are discharged into the arterial system supplying a joint, and an *acute onset* occurs.

A third manner in which an acute manifestation may arise in the case of joints is fairly frequent; it is when there exists a chronic tuberculous osteitis in the bone which gives rise to but few symptoms; this eventually reaches the surface either at the point where the periosteum, capsule, and synovium unite, and there infects the soft structures, and probably the cavity of the joint; or it originates just beneath the cartilage, and spreads laterally beneath, and eventually through it, and infects the joint cavity directly. In both cases there is an acute manifestation of synovitis or arthritis.

In the hip and shoulder, where a considerable amount of bone is intra-articular, spread of an osteitis to the surface is a frequent mode of infection.

It is generally a *slight* injury which predisposes to the development of tuberculosis; this is due probably to the fact that such a lesion results in very little reactionary hyperæmia and repair, such as would efficiently destroy any organism present, and, secondly, that such a lesion receives no notice, and therefore no treatment, whereas a severer lesion results in considerable hyperæmia, competent to destroy the micro-organisms, and treatment *is* directed to the local condition, while the general state of the patient's health is attended to also.

PATHOLOGICAL ANATOMY.

(1) The changes in the SYNOVIAL MEMBRANE.

When the inflammation is due to tubercle bacilli, the round cell exudation common to all inflammations (page 16) has certain peculiarities.

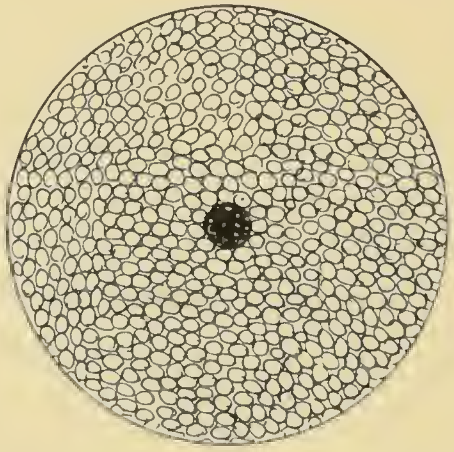

FIG. 43.—A miliary tubercle.

(1) The cells are not at first diffused, but localized into spherical masses generally surrounding a small vessel or capillary. These spherical masses are called *miliary tubercles.* To the naked eye they appear as grey, opaque spots, often smaller than a pin's head; they may be few, or universally studded through, or on the surface of the tissue involved.

In the acute types the cells consist principally of leucocytes (lymphocytes).

The toxins developed by the bacilli present in the miliary tubercle are very destructive, and the cells are destroyed by a peculiar form of fatty degeneration which is evidenced to the naked eye by the change into a yellowish-white colour—the process is called caseation.

In the more chronic types the round cells consist of fibroblasts (epithelioid cells) and lymphocytes. The fibroblasts are collected centrally with a circumference of leucocytes.

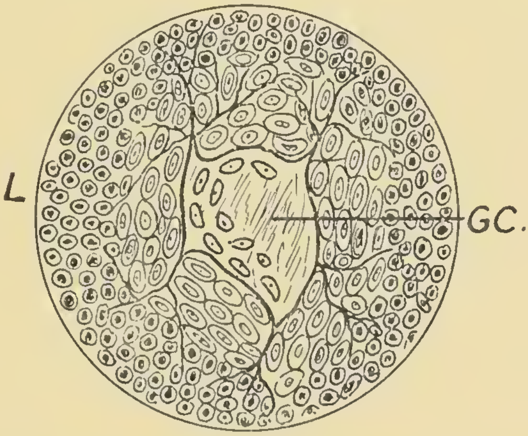

FIG. 44.—A giant-cell system. *GC*, giant-cell surrounded by a zone of fibro-blasts, outside which are the lymphocytes—*L*.

Very frequently, when chronic, the actual centre of the miliary tubercle consists of a very large cell, *a giant cell*, and around this is arranged the fibroblasts, and outside both the lymphocytes.

Caseation may occur, or the fibroblasts may become converted, by a very low form of vascularization, into granulation tissue, which presents a semi-translucent character of pinkish colour.

When the tubercles are numerous the whole synovial membrane is converted into granulation tissue.

If repair is going to take place the bacilli die, the number of blood-vessels increase, and the young fibrous tissue becomes better formed, and a thickened synovial membrane is produced.

It is puckered and altered to a considerable degree, but its endothelial surface reforms and it performs its functions normally.

If, however, folds and fringes of young organizing granulation tissue have long remained in contact with each other, or with the cartilages, or bone surface, or other structure, dense adhesions form (see p. 12).

If the process, however, is going downhill, caseation soon occurs in the badly-formed granulation tissue. These areas appear as yellow cheesy masses, which are very friable and break up easily.

Under these circumstances the cheesy, caseous masses are thrown off into the effusion which usually exists, and float as the typical curdy masses seen in tuberculous abscesses.

The process may begin chiefly in the substance of the synovial membrane, or on its free surface; sooner or later it becomes universal, by reinfection with the bacilli freed into the joint cavity, or by direct continuity.

When a fold or fringe, which lies on and in contact with cartilage, becomes converted into granulation tissue it erodes the cartilage—which undergoes the changes described on p. 21—and granulation tissue replaces it.

When the granulation tissue has penetrated through the articular cartilage it attacks the bone, and rapidly spreads in the plane between bone and cartilage; the remains of the cartilage are, in this way, cut off from the bone and it dies (necrosis), and becomes cast off into the joint (exfoliation).

Once this state of exposure of bone occurs symptoms become much more severe, and the prognosis as regards functional activity much graver.

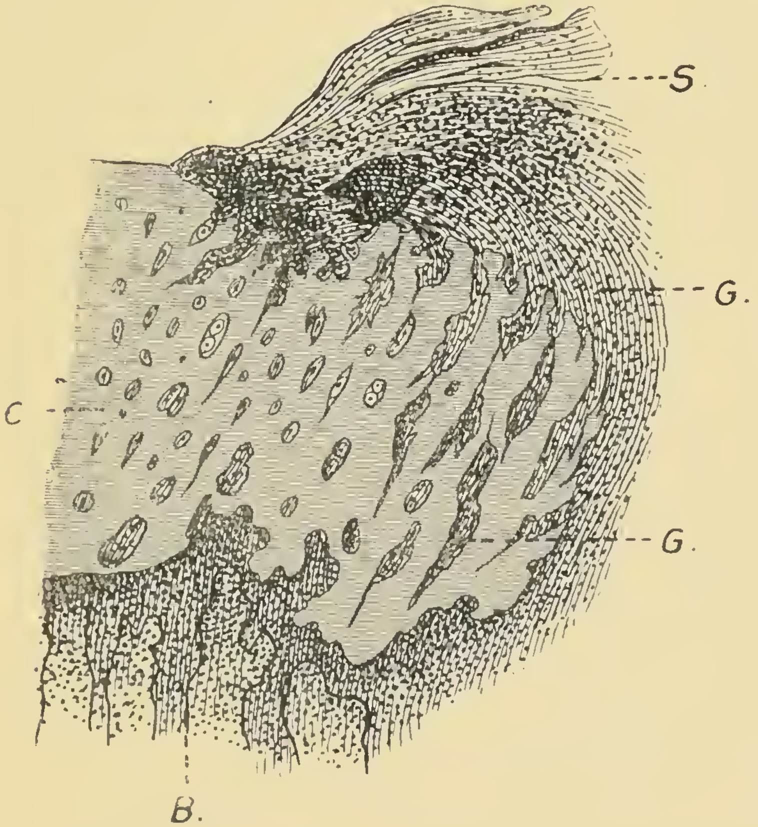

FIG. 45.—(After Paul). The destruction of (*C*) articular cartilage by tubercular granulation tissue spreading from the synovial membrane (*S*), and bone (*B*). Note the irregular cavities in the cartilage filled with (*G*) the granulation tissue. Towards the left the cartilage is normal.

In the same way the capsule and ligaments are first softened by the inflammatory exudation and toxins, and then become converted into granulation tissue.

When recovery ensues in these advanced cases, ligaments, capsule, and synovial membrane may form one dense fibrous layer, holding the bones firmly and immovably together.

Also, if as a result of neglect or bad treatment pathological dislocation has occurred, replacement of the surfaces is most difficult, and in bad cases almost impossible except by operation.

As a result of the extension of the granulation tissue formation from synovial membrane to the capsule the latter is finally perforated, and the subcutaneous tissue, and finally the skin, is invaded by the process, followed by the caseation of the tuberculous granulation tissue ; in this way the skin finally ruptures and the caseous material is extruded ; the orifice so formed leads by a sinus into the joint, generally to some carious bone.

Sinus formation is a grave complication, as it is almost certain to be followed by septic infection from the skin, and this makes it much more difficult to cure by ordinary measures, although, fortunately, this is not so to any great extent *if Bier's congestion method is used.*

Still it increases the length of time necessary to effect functional cure ; it predisposes greatly to the formation of adhesions, and in every way should be obviated.

Hence the practitioner who opens a tuberculous joint and produces a discharging sinus is assuming a grave responsibility which he would be wise to avoid.

Aspiration, or incision with immediate closure, is the only sound plan of dealing operatively with tuberculous joints.

(See later for Details and Precautions, p. 264.)

THE BONES.

Tuberculosis begins in bone in one of three places :—

(1) In the medulla of the cancellous extremities, *i.e.*, central.

(2) *In Adults.*—In or near the plane between bone and articular cartilage.

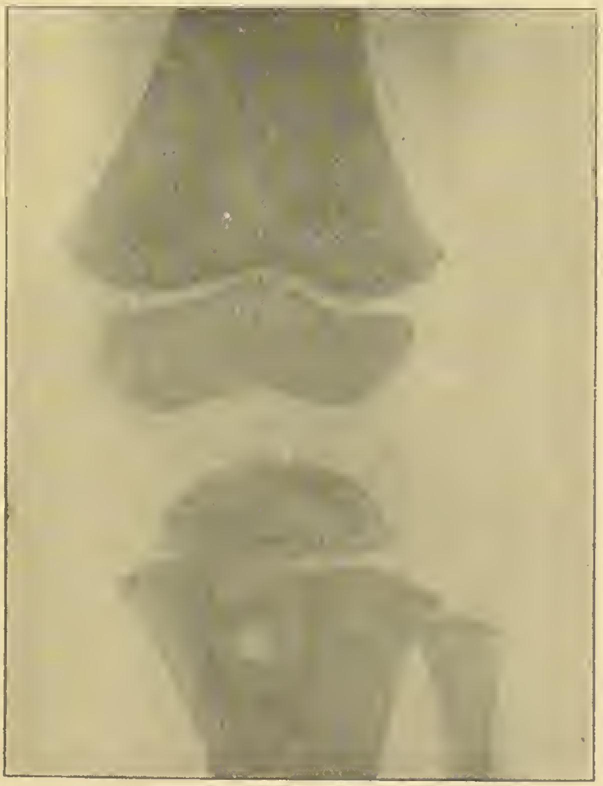

FIG. 46.—A focus of tuberculosis in the head of the *shaft* of the tibia ; it has extended into the epiphysial line and is spreading laterally therein, and also invading the epiphysis (see fig. 47).

In Younger Subjects.—In the epiphysial line connecting the epiphysis and the shaft.

(3) In the periosteum.

In bone the process is essentially the same as in soft structures. The miliary tubercles are formed in the Haversian canals and the *spaces* of the bone, the calcified material of the trabeculæ is dissolved or eaten away by *osteoclasts.* It, the calcified portion, impedes the process mechanically, just as it is harder to drill a hole through hard wood than through soft; otherwise the actual bone plays no part in the process.

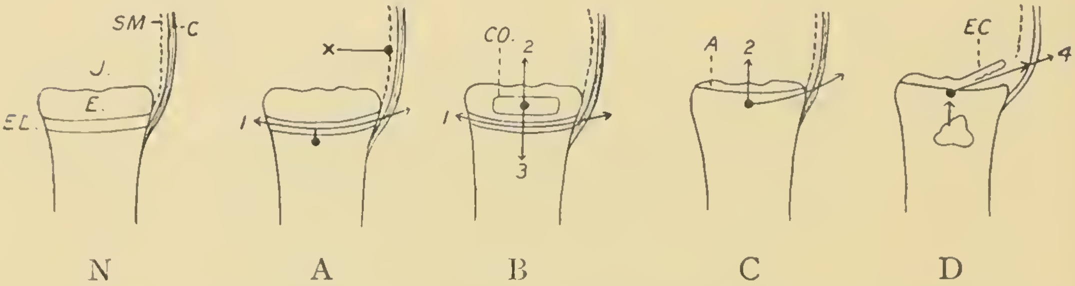

FIG. 47.—A scheme illustrating the incidence of tuberculosis. The first three figures represent the bones in youth, while the last two are fully formed. *J*, Joint cavity; *E*, epiphysis; *EL*, epiphysial line; *C*, capsule; *SM*, synovial membrane.

A.—Tuberculosis may originate in the synovial membrane, *x*. Usually it begins on the diaphysial side of the epiphysial line. It may thence extend into the *E* line and progress laterally in it until it reaches the circumference, where it infects the synovial membrane and capsule (see arrows). It may extend *through* the epiphysis into the joint.

B.—When a centre of ossification has formed in the epiphysis (*CO*), tubercle may originate therein, and may progress in the various directions indicated by the arrows.

C.—In the fully-formed bone the disease begins either immediately subjacent to the articular cartilage or at some distance from it (D). It may extend directly through the cartilage into the joint, or by extension in the plane between bone and cartilage it may secondarily affect the synovial membrane.

D.—Here an abscess is shown in the shaft; the disease has extended to the subcartilaginous plane, and is shown exfoliating the articular cartilage (*EC*). In addition the periosteum may be the primary site of the affection.

The granulation tissue once formed goes through the same changes as in any other structure, and caseation occurs.

CARIES NECROTICA, SEQUESTRA.

Every *particle* of calcified material is not of necessity dissolved or eaten up in a tuberculous patch. Some remains; if the portions which remain are large, they form palpable particles, and the process is called *caries necrotica*, *i.e.*, the bony particles are dead but the salts are undissolved.

This simply means that certain portions of the bone are so completely deprived of their blood supply by the thrombosis and destruction of blood-vessels and the formation of granulation tissue around them that they die *en masse*. If one drills a large number of holes to form a circle in a piece of wood, the enclosed portion falls out; if it were a living structure its blood supply would gradually be cut off as the circle of holes neared completion, and it would die. So with a necrotic piece of bone. The circular piece of wood might be very much worm-eaten, *i.e.*, friable and easily broken down; and this is the case with the necrotic piece of bone—it is usually very porous (carious) by invasion of granulation tissue *previous* to its death.

Returning to the simile of boring a circle of holes: if the circle of holes is not quite complete the piece of wood may be just held in position by the undrilled bridge; so with a necrotic piece of bone; later the bridge may break or be perforated by another hole, and so the *sequestrum* is set free.

If as each hole is bored one stuck a piece of webbing across it, the piece of wood would not fall when the circle of holes is completed, but would be held in position by the webbing. Here the webbing represents the granulation tissue which is found binding the necrotic portion to the rest of the bone; if the webbing becomes rotten, *i.e.*, the granulation tissue caseates or suppurates, the necrosed bone is set free and is now a loose sequestrum.

The sequestra found in tuberculous processes are *very* carious. easily broken up, and consist very largely of granulation tissue, so that a sequestrum of quite a good size will crumble away into small particles if the granulation tissue caseates and breaks down, so that the small particles can be evacuated through a cannula or aspirating needle when the abscess is tapped.

Any specimen of spinal caries shows that cartilage is more resistant to destruction by tuberculosis than is the cancellous bone.

It is stated that a sequestrum may be surrounded by a dense layer of bone; this usually occurs when the tuberculous process is very chronic or subsiding; its pathology has been described on p. 22.

Clinical Signs and Symptoms.

In brief the history of a tuberculous joint when *primarily synovial* is that of a *chronic synovitis of insidious onset*, whose progress is steadily worse, and which leads to marked changes in the joint and eventual crippling, associated with progressive constitutional disturbance.

If the bone is primarily involved.—In the early stages the patient may complain of a *boring* or *dull aching pain* in the region of the joint, generally worse at night (probably because the attention is then not diverted); there is not infrequently a sense of weight. Jarring, such as produced by jumping and brisk walking, is not liked, and the patient under these circumstances minimizes the jar and shock by *limping*.

If the upper limb is involved he is very careful not to jar the hand or arm, and the use of the limb is restricted more and more.

Examination.—If the bone affection has existed some considerable time, a certain amount of *tenderness* on firm pressure or percussion may be found, or slight increase in the *thickness* of the bone; this is generally very small and gives one the *impression* that it is so, rather than is demonstrable, although true periosteal deposit may occur with definite increase in thickness of the compact layer—erroneously called expansion of bone. The impression of increased size is usually due to thickening of the periosteum, and a careful examination for *œdema* should be made. Obvious and gross local enlargement may occur.

General Condition.—If a four-hourly chart is kept in such a case, a slight rise of temperature is the rule, generally towards evening, and perhaps reaching 99·6° or 100°, not regularly but in a manner corresponding to unusual use of the limb or some exacerbation of the symptoms.

If the previous health and family history is suggestive, and the patient "looks tuberculous," or recent indisposition of an indefinite character or an "influenzal" attack, with perhaps the history of an abscess as a child, or rather bad cough for some winters, is elicited, and the ABSENCE *of a septic focus anywhere* can be definitely established, the patient is practically certain to be suffering from tuberculous osteitis in immediate proximity to a joint.

A tuberculin test carefully carried out will confirm the diagnosis.

But as tuberculin *injections*, although the most reliable, are not free from danger, the safest test to adopt is a von Pirquet's test. I think the Calmette eye test is best avoided.

Personally, I candidly confess I much prefer a good X-ray examination, which will always, in the hands of a good radiographer, give positive results concerning the suspected area sufficient to establish the diagnosis; whereas a test may be positive, but the real tuberculous process may exist in some other part, the joint lesion being of a different nature.

Course of the Symptoms.—Sooner or later if untreated such a case gets worse and new symptoms develop.

(1) Either rather suddenly the joint becomes swollen and acutely painful, and a rapid synovitis is set up, with more effusion than usual in tuberculous cases *beginning* in the synovial membrane.

(2) Or the *limp* becomes definite, the *movements* of the joint gradually restricted, *pain* of a more pronounced character on movement, or perhaps *starting* pains at night develop. The joint is held definitely *flexed* and carefully protected from jars and wrenches.

The *former* condition occurs when the cartilage is perforated or exfoliated and an acute joint infection is set up (see fig. 47, D).

The *latter* when the spread takes place by the infection of the synovial membrane at its junction with bone and periosteum, *i.e.*, a more gradual process at first extending by continuity.

EXAMINATION.

In the acute condition first described, which is the rarest form to see, the LOCAL SIGNS are those of an acute synovitis, with modified evidence of inflammation.

The *swelling* is usually more moderate in degree than that due to a septic infection, and retains the shape of the synovial membrane, but so rapid is the atrophy of muscles in these cases—it really has been going on for some time—that the joint looks larger in proportion than it really is.

There is generally *no redness* of the skin or, at most, a slight difference in the tinge.

The *position of the joint* is that of the greatest ease, semiflexed, semipronated, &c.

Heat.—The skin is *always* hotter than the normal, although the hand may not be competent to detect it in all cases. (This holds true to instrumental tests in all forms of tuberculosis).

Œdema of a mild degree can generally be made out somewhere by the finger-nail test, and frequently bogginess and pitting can be detected.

Fluctuation.—In this condition true fluctuation is found, as distinct from the quasi-fluctuation of the forms in which the swelling is chiefly due to granulation tissue.

In *palpating* the joint the *tenderness* is never so marked as in traumatic or septic synovitis.

There is but little increase in thickness of the synovial membrane, whereas in the primary synovial cases the whole swelling may consist of a thickened membrane and granulation tissue.

The *function* of the joint :—

All movements are MARKEDLY restricted even before erosion of cartilage takes place ; when the latter occurs, owing to the cartilaginous destruction, none but the gentlest and slightest movements are ever tolerated ; and when these are attempted the pain produced is excessive and may make the patient cry out.

The *spasm of muscles* is pronounced.

The *wasting* (*and spasm*) of the muscles is rapid and excessive. This atrophy is so acute and marked that a much-wasted limb usually exists.

Certain muscles are specifically affected, but all the muscles atrophy to some degree.

In the second class of case, which resembles the so-called primary synovial infections, the signs and symptoms are described under the heading of a "Typical Tuberculous Joint."

The *difference* lies in the amount of damage which the cartilages may have sustained in the primary bone lesion, and which always INCREASES—

Spasm of muscles.
Limitation and pain in movement.
Starting pains at night.

Primary Synovial Tuberculosis.

There are two types of cases:—

(1) The rarer cases in which a LOCALIZED proliferating synovitis occurs with formation of enlarged villi, and pedunculated granulation tissue masses, which progress steadily, corresponding to a gummatous mass in syphilis, and very difficult to diagnose on the local condition alone.

There is generally some effusion.

The movements are very little affected; the pain is slight; some local thickening is felt and the condition rather resembles an exacerbation of osteo-arthritis, except for the *slighter* degree of pain in the tuberculous condition.

The enlarged masses may be felt rolling under the finger resembling the fibro-fatty fringes found in various chronic joints.

Over the thickened areas ŒDEMA AND SLIGHT PITTING can often be found, and afford valuable evidence of tuberculosis.

The general condition, previous history, and the absence of *other causes of synovial disease* will put one on guard and lead to a diagnosis.

(2) *A diffuse thickening of the synovial membrane—*

i.e., TYPICAL TUBERCULOSIS.

To be precise a diffuse synovial involvement *may* be associated with a hydrops of an acute kind which is rare, and in the early stages simulates a mild septic arthritis.

Generally the thickening begins locally, as described above, spreads steadily, and soon involves the whole synovial membrane, and converts it into a pulpy œdematous mass of granulation tissue with slight effusion.

On the authority of König, it is stated that it is not uncommon for many joints to be almost simultaneously affected by an effusion, but that the majority clear up while one progresses steadily downhill into a typical tuberculous joint.

TYPICAL TUBERCULOSIS. EXAMINATION.

Pain is at first slight, and when the joint is at rest none may be experienced.

All movements produce *discomfort*, however.

Swelling.—This is moderate in degree, and corresponds at first in outline to the synovial membrane;

sooner or later it becomes irregular in shape, and finally the joint becomes bulbous or spindle-like.

Redness.

The skin is invariably of normal colour (hence the name "white swelling").

Heat.—In every case of tuberculosis there is increased temperature. This *must* be *fairly* tested—*i.e.*, both joints must be exposed equally as regards time and clothing.

The palmar aspect of the hand and proximal phalanges are used.

The *same* hand must test both joints. I think it is wise to first feel the normal joint; it is easier to feel up, as it were, than down—*i.e.*, detect increase in temperature than decrease.

Œdema can generally be made out by the finger-nail over some part of the joint, and here a sense of increased bogginess or softening, or decreased firmness is to be expected. Compare similar points on both joints.

Fluctuation (see p. 36).

This *is* felt, but it is not true fluctuation (unless there is also effusion, and, of course, a time comes, if the granulation tissue breaks down into "pus," when true fluctuation is felt). It is not uniform; it is lost if the fluctuating fingers are placed at extreme limits of the swelling.

If deep pressure is kept up by one finger a certain amount of *pitting* may be found which is not present over a true fluid swelling.

At the periphery of the swelling the thickened membrane may be felt, or localized thickenings over fringes detected.

Posture.—In the really early stages this may be normal, but gradually flexion arises, *i.e.*, the posture of greatest ease for the particular joint (see Special Joints).

Movements.—At first they may be of full range and free from pain ; but gradually limitation occurs to ALL movements, active and passive, and in all directions, and pain is excited, with reflex spasm of muscles. However early one sees these cases they always carry out movements very carefully and generally slowly. *Occasionally* creaking is felt, due to rice bodies, roughened synovial membrane and lymph exudation.

The muscles show early and marked wasting. This is always a feature of great importance, as it is more marked and earlier in tuberculosis than any other type of arthritis.

The *spasm* is not so marked as in acute suppurative or infective synovitis or arthritis, but once bone is exposed the joint is held very rigidly by the contracted muscles. The wasting also exaggerates the size of the joint, which in this type of tuberculosis tends to assume a somewhat spindle shape or a globular outline.

A method of diagnosis not sufficiently often used in doubtful joint cases, with or without effusion, is the employment of an exploring syringe and the removal of fluid or minute fragments of the thickened synovium and its injection into a guinea-pig, the most reliable of all tests for tuberculosis.

If a bone abscess or a localized abscess in the synovium bursts into the joint and infects it an acute condition is set up, which is difficult to diagnose from acute or subacute septic infections, unless the preceding condition is carefully inquired into or a skiagram of the bones taken.

If treated carefully with a *maximum* amount of rest, &c. (see later), it will subside and then the typical pulpy granulation tissue degeneration sets in and pursues the ordinary chronic course of tuberculosis.

Exacerbations will occur from time to time in any case when rapid breaking down sets in—or when cartilage is destroyed and either a fresh portion of bone or other structure becomes involved. After each such attack increased crippling is observed, or some evidence of breaking down is manifest—œdema, beginning redness of skin, local tenderness and increased local pain, often of a throbbing character; a change in the outline of the swelling, and when the abscess has developed and especially if it has become subcutaneous, definite fluctuation appears. The *general health* of the patient suffers in proportion.

If a capsule suddenly "gives" relief of pain and tension is experienced, with amelioration in the general symptoms also, *but soon increasing symptoms return and a new swelling becomes apparent.*

When an abscess bursts externally the relief is more marked, but unless scrupulous care and *asepsis* is maintained, septic infection occurs and then all signs and symptoms are likely to increase, especially the fever, general debility, loss of appetite and the inability to obtain sufficient sleep. The joint disorganization goes on rapidly, the capsule and ligaments are destroyed or stretch, and a pathological dislocation very frequently occurs. Sinuses form in other directions and the condition becomes very grave.

THE PROGNOSIS.

This depends upon various factors, very largely upon the pecuniary circumstances of the patient and the ability to carry out the local measures, provide ample food and good hygienic surroundings, but in my opinion even these are overshadowed by the *type of treatment* adopted.

The belief is so prevalent that the essential thing in "open air" treatment is the actual air, that I wish to emphasize the fact that all we need is *physiologically sufficient* good air; open-air treatment derives its credit from the concomitant advantages, which consist in the opportunity being given the patient to avoid boredom, in moving about, change of thought and companionship, the development of appetite, as also the development of healthy fatigue and the desire for sleep, *i.e.*, a healthy action and reaction. Generally also it means that for the time being older patients forget their other anxieties.[1]

It is freely stated that ankylosis and adhesions are to be expected as the *invariable* result of tuberculosis in joints. If we exclude the knee for the moment, this statement is most fallacious and cannot be too strongly deprecated; and instead, a functional joint must be the ideal aimed at, as it *is*, by proper procedures, with increasing frequency attained.

With proper reservations one may confidently state that generally speaking operations of a set type effect less good *functional* results than does careful non-operative treatment.

Operations are necessary and are most successful in saving life and limb, and, as will be seen later, in their proper place will be fully credited; but if one has charge of a case of tuberculosis from the beginning, then one's best results will be obtained without resort to set operations.

---

[1] W. C. Bosanquet, *Brit. Med. Journ.*, January 21, 1911.

The Local Treatment.

This may be divided into two different classes :

(*a*) *The Non-operative.*

(*b*) *Operative.*

THE NON-OPERATIVE.—(1) The *older* method was that of absolute fixation in a splint until cure was affected.

Although formerly complications in the form of abscess were treated by open operation, now it is almost the universal rule to employ immediate closure of all wounds made for the discharge of tuberculous pus.

(2) The *newer non-operative method* is fairly subdivided into—

(*a*) That embodied in Bier's congestion hyperæmia and its corollaries.

(*b*) The *use of fixation* without Bier's methods, but employing in conjunction various minor operations for the introduction of chemicals, such as iodoform glycerine, or inert bodies, charcoal, bismuth, calomel, &c., in emulsion, Morton's fluid, carbolic and other chemical antiseptics.

THE OPERATIVE METHOD by which complete extirpation of the tuberculous disease is attempted.

It may be stated without hesitation that with the exception of the knee-joint, which will be discussed later, set operations have proved disappointing and are not now usually adopted as a routine treatment.

It is so often lost sight of that all tuberculous lesions of a local nature do tend to heal, and that often with quite good functional results.

The clinical phases of tuberculosis of joints serve to provide a guide to the discussion of the treatment; we may have to treat the disease in varying conditions and degree. For instance:—

(1) When the disease is still confined to the bone, or is strictly localized in the synovial membrane.

(2) When the synovial membrane is widely affected, with so-called purulent effusion and caseation proceeding, but the bone is not exposed.

(3) When the cartilages are eroded and bone is freely exposed, the so-called chronic ulcerative types.

(4) When there is peri-articular tuberculosis, with extra-articular abscess with or without sinus formation.

(5) When complete disorganization of the joint exists, with or without pathological displacement or other deformity, and with or without abscesses or sinuses.

(6) In the conditions called hydrops (chiefly serous effusion), or empyema (purulent effusion).

(7) When the general health is profoundly affected.

It is my intention to confine myself chiefly to *Bier's congestion hyperæmia, and the technique most suitable for use with it.*

It is, as a rule, so imperfectly dealt with, and but scant justice done to it in most English text-books, whereas the other methods are fully elaborated, that I wish to place it where it deserves to be, as proved by my own experience of it during the past ten years—

namely, in *the first place*, in the treatment of tuberculosis.

It is applicable to almost *all* stages, while it *excels in some*, and whereas all other methods are gravely interfered with when sinuses have formed, it is certainly my experience that cases with sinus formation, instead of being more troublesome, more often respond quicker and more effectively to Bier's bandage than any other stage of the disease. The acuter vascular phenomena associated with septic infection appears to aid the treatment.

Minor operations are combined when such are deemed advisable, but set operations are not peformed without a very definite reason, usually for deformity.

It is always asked what happens in caries necrotica, and when there are sequestra. Well, two things may follow the use of Bier's bandage :—

First, the carious bone may be entirely repaired. The tubercule bacilli die, the granulation tissue becomes healthy, the necrotic portions are probably eaten up by osteoclasts, or liquefied and absorbed, and new bone forms in the usual manner.

As previously stated the *sequestra* of tubercular origin are usually soft, friable, and carious ; they consist in the main of multiple particles of bone bound and held together by granulation tissue ; in fact, of an aggregation of caries necrotica, and the behaviour of a sequestrum under the beneficent action of a Bier's bandage is similar to that of caries necrotica.

Secondly, generally when the amount of disease is considerable, or the technique *in error*, the granulation tissue in the carious patch, or forming the main mass of the sequestrum, rapidly caseates and liquefies into so-called pus and an "abscess" forms, in which the bony particles are set free. Under these circumstances the abscess is evacuated by the modern methods with immediate closure, &c. (see later).

The rarer forms of sequestra found in tuberculous disease of dense bone must be eventually removed, as also the softer varieties if there is a sinus present, and they do not become absorbed, or come away gradually in the pus.

Having stated that neither caries necrotica nor a sequestrum is a bar to the use of Bier's bandage, it is best at first to put the patient to bed when the lower limb is involved.

As, unfortunately, the hip cannot be treated effectively by a bandage I will refer to its treatment later.

The limb in the earliest stages need only be bound to or rested on a pillow; *it must never be permanently confined in a splint.*

In the synovial cases the desirability or not of a slight extension will depend on whether *any* spasm of muscle exists.

There are *two methods* of using a Bier's bandage in tuberculosis.

(1) The Intensification Method

(2) and the Moderate Congestion Method.

The situation for the bandage is as far above the disease as it can conveniently be placed; the upper arm and thigh, therefore, are always used.

For a thick, fleshy, or fat thigh a strong, wide, 3-in. elastic webbing bandage is used (not a Martin's nor Esmarch's), directly on to the skin, the turns well overlapping one another.

If the patient is thin or has a sensitive skin the bandage is applied over several layers of muslin or soft flannel.

The Moderate Congestion.—In this method the bandage is applied in the manner usually employed for septic processes (see p. 470). For three or four days it is worn for three to six hours (the latter is never exceeded, and but *rarely* used in tubercular cases), *i.e.*, till the painfulness of the joint, if present, is considerably reduced.

(2) Then the time is reduced to about half (generally not more than three hours), for about ten days, and gradually reduced.

(3) Afterwards it is worn *one hour daily;* but if the case is obstinate, it may, however, be worn for two or three hours, never longer than three hours.

In these obstinate cases I personally prefer to use the bandage one or one-and-a-half hours twice, or in some cases even three times in the twenty-four hours.

The Intensification Method.

The bandage is applied so firmly that a "vigorous congestion hyperæmia is produced." The subcutaneous veins swell considerably, the skin becomes bluish-red.

At the end of an hour a slight prickly sensation may be felt, BUT NEVER PAIN NOR VERMILION SPOTS.

The limb swells perceptibly, but no demonstrable œdema appears.

This method is now considered the best, and it can be carried out and supervised entirely by the practitioner. The whole secret depends upon the correct degree of tension, and this must be graduated carefully. When endeavouring to find the correct tension, ask the patient if she or he feels the slightest tingling or numbness either near the bandage or at a distance. If this is experienced, slacken the bandage till it quite disappears, and fix it at that point. Should the sensory phenomena reappear before the expiration of the hour the bandage must be further relaxed, until at last a tension is reached by which the slightest tingling or numbness is just felt at the end of the hour.

It is almost impossible to produce œdema in one hour by this method; but in any case permanent œdema *must not appear*, and all trace of such must be removed before the next application.

After continuous treatment with a bandage for a month or six weeks, it is wise to intermit for a few days, and then either to continue with the hourly application, or to go through the moderate congestion process afresh.

The foot and ankle invariably respond well, as hyperæmic reaction can always be obtained.

In the case of the *knee*, results are much more uncertain, and it is at times necessary to apply mild counter-irritants, or alcohol compresses before a reaction can be induced. (Bier advises hot-water fomentations, which he believes produce a mild skin inflammation, not a hyperæmia).

Also during the intervals the wool compression bandage may be worn for three to six hours, and under these conditions the knee will usually react to the passive congestion.

In the *hip cases* the local suction glasses alone can be used, and should be resorted to (see Hip, p. 314).

In the case of the upper limb all joints respond favourably, and generally quickly.

Under all methods of treatment *cure* of a tuberculous joint occupies anything from one to three years. Bier's method shortens this considerably, the average time occupied being nine to ten months; but it is best persevered with for a year or more in the case of the ankle, foot, shoulder, elbow, wrist, and hand. With the knee a longer treatment is necessary.

The greater virtue of the congestion methods lies in the better functional results obtained.

The Treatment of Abscess.

It must be remembered that the ideal is to immediately close all incisions leading to a tuberculous focus; hence, especially with Bier's methods, aspiration is eminently suitable.

If, however, it is likely that the fluid is very thick, the abscess must be *efficiently* incised, *i.e.*, the opening permit free exit to the fluid, lymph, and caseous *débris*, and yet will not become obstructed by granulations for some days, varying from three to twelve or fourteen, according to the pathological condition present, and especially as to whether a sequestrum is or is not present.

When the incision is made, the cavity may be flushed with saline and the floating solids *gently* expressed, but CURETTING MUST BE AVOIDED, and chemical antiseptics are unnecessary.

Relief of tension and removal of all free substance only is necessary.

If the joint is movable, movements are carried out when Bier's bandage is on, to aid expel the contents.

When the bandage is removed, the suction glass is applied; both are not used at the same time.

Having made an incision, the suction glass is always henceforth used daily (see Details, p. 492).

It removes the fluid and stimulates healing of the sinus, *which it keeps sterile.*

As it is possible for the skin around the sinus to become infected with the tubercle bacilli contained in the escaped fluid, this is guarded against by smearing the neighbourhood of the orifice for 2 or 3 in. with STERILE vaseline, over which the suction glass is applied. After the *séance,* this vaseline is removed, and the skin cleansed with benzene (alcohol or ether may be used), and then fresh sterile vaseline applied; this is removed before the next application of the glass, and so on.

In cases in which the sinus remains open for some time, and the orifice becomes small, the sides are apt to come together and prevent the outflow of pus or serum when suction is applied. In such a case a sterile rubber tube is inserted just prior to the employment of the suction glass, and removed immediately after the last application of the glass, *i.e.*, it is NOT worn permanently.

Indications of improvement under Bier's method (both bandage and glass) are those usual to all methods of treatment, but, in addition, especially when the glass is used, there is *increasing firmness and hardness* of the granulation tissue, an evidence of the formation of healthy fibrous tissue.

Abscess treated by Aspiration or Tapping and the Injection of Sterile Substances.—Suspension of iodoform, 10 per cent. in glycerine, is the best of the substances used for injection. Morton's iodine fluid, carbolic, calomel, and bismuth in suspension in mucilage or glycerine are also used.

The iodoform glycerine must be prepared as stated on p. 454.

The abscess is punctured in a valve-like manner through *healthy* skin.

Having cleansed the skin by gently rubbing with acetone and then swabbing the area with rectified spirit, a local anæsthetic is used or gas administered, the skin is punctured with a knife and the aspirator or trocar passed through the puncture just into the abscess cavity ; GENTLE pressure only should be used to expel the pus if a trocar is used.

Then about half the quantity of pus removed—never more—is the maximum quantity of iodoform-glycerine injected the first time.

Iodoform-glycerine acts best when moderate distension of the sac is produced, and when firm pressure is exercised on the whole area of the distended abscess sac.

The full details are given on p. 456.

It is wise to suspend the Bier's bandage (and suction glass) for a few days after each injection ; but when the acute reaction, local and general, has subsided it may be resumed, but it must be used very cautiously and the effect on the abscess wall observed ; its general effect when used with iodoform-glycerine is to produce a rapid breaking down of the granulations and cessation of the spreading of the tuberculous process.

When the Disease is confined to the Bone or a Localized Part of the Synovial Membrane.—The patient is put to bed or confined to a couch for the first few days while the correct tension of the Bier's bandage—using the intensive method for one hour—is ascertained.

After the correct tension is found the bandage is used in the morning and then the patient rests with the limb elevated for some two or three hours. After which he may be about all day if a patten is worn on the sound foot and crutches are used.

Limbs subjected to congestion hyperæmia soon get to feel very cold after the removal of the bandage and must be kept warm.

No retentive apparatus is necessary, but in the case of children who will not be restrained, and in the case of the poor, a poroplastic mould may be a wise safeguard.

It is removed when the patient is at rest and the limb is then exercised carefully ; jars, strains, wrenches or blows must be avoided. It is never worn at night, unless there are starting pains, when a mild extension is the best treatment.

Evidence of improvement will be confirmed by X-ray examination in the bone cases and by the hardening and shrinking of the synovial patches.

In the localized synovial cases *interstitial injections* of iodoform-glycerine are given if the improvement is delayed, or the disease appears to be extending ; they must be used cautiously so as to avoid rapid breaking down into pus, although if this forms it may be aspirated, the best results are obtained by inducing dense fibrosis without pus formation.

If the practitioner does not adopt this latter treatment and still the condition hangs fire, stimulation applied to the skin in the form of mild counter-irritants (p. 48) may start improvement.

Or the laboratory method of tuberculin injections may very cautiously be adopted.

An early to bed and late rising policy is to be pursued.

In all cases of tuberculosis the removal of *all foci of septic infection in other parts of the body* is most important, and if the sepsis affects the gastro-intestinal system the result of its cure is usually most marked; a tuberculous synovial or bone lesion which may have resisted all efforts directed to its improvement will begin to improve almost immediately the gastro-intestinal system is made healthy. I have observed this takes place constantly, after the removal of septic stumps or the cure of other oral and nasal sepsis.

Another point which will be included under general treatment, but which I wish to emphasize here in discussing delayed improvement, is the great value of *fresh raw meat juice* in the dietary.

When Bier's Method and Iodoform-Glycerine is not employed.—Rigid fixation in splints or plaster of Paris, the use of severe counter-irritation, even the actual cautery, also elevation, and in the synovial cases pressure, is advocated.

Also the usual hygienic and general treatment. But I wish strongly to deprecate *complete* fixation in these cases, and generally in tuberculous joints.

Operative treatment aiming at the complete removal of the deposit in bone or synovium is suggested, which at first sight offers the best form of treatment, but which in actual practice does not afford the good results suggested, sufficiently often, to recommend its adoption in preference to Bier's method.

When the Synovial Membrane is widely affected but Effusion is slight.

In these cases I think gentle extension, with at first absolute rest in bed, is the correct treatment to use with the Bier's bandage for one hour daily.

The object of the extension is to overcome the tonic contraction (spasm) of the muscles, and so limit the amount of pain and of pressure necrosis on the cartilages; it is of use only in shoulder, elbow, hip and knee affections, as in the case of the ankle, posture by flexion of the hip and knee will relieve the spasm fairly effectively, while extension at the wrist is effected by splints.

It must not be forgotten that the Bier's bandage aids markedly in relieving the pain and the spasm.

It is generally stated that absolute fixation is desirable, but that this is the wrong line to adopt I feel convinced, and on the contrary any gentle active or passive movements that can be carried out are beneficial and must be encouraged. Hence the patients are encouraged to perform voluntary movements, and especially when the Bier's bandage is on.

As the swelling becomes firmer and begins to shrink, the patient is put into an easily removable poroplastic mould and he is permitted to get about, using crutches and a patten, when the lower limb is affected. This is much preferable to being wheeled about in an invalid's carriage.

In a suitable patient a firm wool compression bandage (see pp. 46, 93) is applied without a splint or retentive apparatus and the ambulatory treatment pursued.

In the case of the ankle, to prevent the equinus which is so easily induced, I think it is best to put on an anterior moulded poroplastic splint, the long arm reaching to the tubercle of the tibia. It is moulded and worn over a fair layer of wool.

Also when the patient lies in bed, wherever the disease is situated, bed-clothes must not rest on the foot.

For the knee a Thomas's splint or a poroplastic is advisable, as this joint is so liable to be jarred and sprained, both of which affect the disease injuriously.

Splints are left off at night and movements of an active character practised every morning and evening.

If the patient is a careful, reliable person, a splint is not really necessary, but it is a safeguard against injury in all cases and advisable amongst the poorer classes.

Every splint, however, must be one easily removed, so that daily inspection and movements may be carried out.

If the improvement is delayed I think interstitial injections of iodoform-glycerine are indicated. The patient must be confined to bed, even in upper limb cases, for about seven days, and a wool compression bandage worn immediately after the injections and removed after five or six hours; sooner if it appears to make the pain worse, as is sometimes the case. It is renewed again after an interval of two or three hours; this alternate pressure and relief is most valuable under the circumstances.

After an interval of twenty-four hours the Bier's bandage is applied for one hour in the morning and the elastic wool bandage reapplied afterwards. Occasional mild counter-irritants are used from time to time if the elastic wool pressure is not effective.

When the Synovial Membrane is widely affected but the Joint contains a considerable Effusion.

The same line of treatment is adopted, but the early part is best carried out in bed, with a slight extension apparatus, the weight varying from 2 to 4 lbs. according to the age and physique of the patient. A splint is unnecessary, the limb is laid on a pillow.

In these cases I believe aspiration, with suitable precautions, is called for either alone or to permit the introduction of a small quantity of iodoform glycerine into the joint, as it must be remembered that a Bier's bandage *does not* aid absorption. Iodoform glycerine to the extent of about a quarter the amount of fluid removed is passed into the joint and firm elastic wool pressure exercised for twelve hours.

Bier says the cases of hydrops (serous fluid) or empyema (pus) are the only cases in which he now uses iodoform-glycerine; he gets better results in the other cases without.

If the pain, under these circumstances, is severe an injection of morphine should be given.

Not sooner than twenty-four hours after the iodoform injection the Bier's bandage is applied but not so firmly as usual; it is worn one hour, and during this time the extension is removed.

If the pain is severe the moderate and more prolonged Bier's bandage may be used to allay it.

There is always the danger with iodoform-glycerine that rapid fatty degeneration and caseation—*i.e.*, abscess formation—may result, but if the quantity used is moderate and the Bier's bandage closely watched, it is not inevitable. I believe the injections hasten the cure and in this respect are valuable. If an abscess forms I am not sure it is not the quickest way to heal the disease in these cases with effusion or when time is important. Functional results can be and are attained after iodoform-glycerine.

If iodoform-glycerine is not used Morton's fluid or carbolic solutions may be preferred, otherwise absorption must be aided by pressure, and Scott's ointment with strapping should be tried. It is an advantage sometimes to use flying blisters, and certain authors strongly recommend the actual burning produced by the cautery, the burn being kept open, if possible, for some weeks by savin ointment, or the cautery reapplied.

In the chronic ulcerative type, when cartilages are eroded and bone exposed, a condition producing extreme pain and especially that form of it known as *starting pains*, and which induce great terror in the patients.

It is at first absolutely essential to use both extension and retentive apparatus for the hip and knee.

In ankle cases posture—*i.e.*, flexion of the knee and hip with a retentive poroplastic splint, either an anterior or posterior variety—suffices without extension.

For the upper limb and ankle I personally prefer poroplastic to any form of splint or plaster of Paris; it is easy and clean to handle, of light weight, easily altered and easily available and can be made into any shape by the surgeon. For the hip and knee Thomas's splints serve all purposes except that the hip splint is looked upon as a permanent fixative splint, whereas it should be removed for purposes of exercise—*i.e.*, movements.

It is in this form of tuberculosis that I have found the use of iodoform-glycerine most beneficial; the joint must be *distended* to a moderate degree and pressure applied. The difficulty is to be certain the needle or cannula is in the joint cavity in the dry cases.

As long as the granulation tissue is not removed by a curette any quantity of the iodoform-glycerine may be injected into an abscess or joint cavity.

The granulations break down rapidly and the distension quickly increases, so that in seven to ten days aspiration is necessary, and as much of the fluid removed as possible.

Less than half the original quantity is now introduced and pressure reapplied.

Further aspirating depends upon how the joint behaves, as after the first rapid breaking down there is much less effusion following each injection.

The Bier's bandage is applied with moderate tension only, beginning twenty-four hours after the injections. Although it may appear to be contra-indicated, the bandage used for a short time—one to two hours—and with moderate tension relieves the pain.

It is obvious that if a movable joint can be obtained *after excisions by operation* it is equally possible to obtain functional joints after exfoliation of cartilage, and this end may be attained in those cases which will tolerate the carrying out of passive or active movements.

Therefore it is unwise to adopt the fatalistic view that there *must* be ankylosis in such cases; instead, do all you can to obtain very slight movements while the Bier's bandage is on and maintain them, if possible, with an increasing range as time goes on.

It is not usually appreciated how great a part the spasm of muscles plays in preventing passive movements (and consequently active movements).

If a mild extension is applied for three to seven days to entirely overcome the spasm, movements are often easily tolerated, and *this use* of extension should be employed to its fullest extent.

The movements carried out may cover but one degree, a very suspicion of a movement, but it is of value and must be persisted in, when it will be found that the range will gradually increase.

Great patience is necessary and the full confidence of the patient must be gained.

There are times when seven or even twenty days elapse without any attempt at movement, but whenever the patient can make a suspicion of a movement it should be done. Extension for a few days will always facilitate this.

When peri-articular abscess exists it indicates a more advanced and chronic state of a highly susceptible patient, and it is very probable that adhesions already exist; hence one must be extremely cautious about moving those joints which are in an advanced condition.

The extent of the damage which may follow an attempt to BREAK DOWN tubercular adhesions cannot be estimated and it is infinitely wiser never to attempt violence in these cases, but to try by continued congestion, counter-irritants, and pressure, combined with persistent attempts at active and passive movements, to stretch the adhesions gradually.

All peri-articular abscesses are either—

(1) Aspirated and pressure applied,

(2) Aspirated and iodoform-glycerine injected, or

(3) Incised and the suction glasses used.

It is probable the last method is the best, as the suction not only removes the pus but actually supplements the congestion and induces healing, not only of the abscess but of the adjacent tuberculous joint. The Bier's congestion bandage is used with either method.

If a sinus already exists an endeavour should be made by the careful use of a probe (a dangerous instrument and one which invariably does damage), or by X-ray, and by the clinical history and anatomical considerations, to determine whether there is a sequestrum at its distal end or not.

If there is a sequestrum it is, I think, wise to enlarge the sinus by incision or by Hilton's forceps method, so that if the sequestrum is already free it may be removed; but if the sinus is tortuous it should not be enlarged by cutting along its whole extent, but the superficial part kept widely open, and the suction glass persisted in; as the sequestrum is finally forced to the surface by the underlying granulation tissue contraction it will arrive at the part of the sinus where it *can* be removed.

If it is not free the suction glass will rapidly cause it to become *free*, and small sequestra are rapidly removed by the suction alone.

Sinus cases do exceedingly well as a rule by the congestion methods.

The functional results depend upon the intra-articular conditions.

The sinuses must never be sharp spooned or plugged, simply treated by the bandage and suction. (See p. 492).

The limb is otherwise treated according to the class of case it belongs to.

Movable joints are often obtained in spite of sinus formation.

If complete disorganization of the joint has occurred, prolonged treatment in bed is necessitated. The active disease is treated by the bandage as already indicated.

The displacement is corrected as far as possible by extension. This applies equally to the upper and lower extremity.

If the foot is concerned it is moulded into position under an anæsthetic, and then put into a splint—anterior and posterior poroplastic or Croft's plaster-of-Paris—for seven to ten days, provision being made for dressing if necessary. After this the splint is taken off for a variable interval, and active and passive use of muscles encouraged, then the splint reapplied.

If the foot can be got easily into good position, however, the firm elastic bandage over wool may be used instead of a splint.

Otherwise an orthopædic apparatus may be necessary.

In the case of the knee it is quite extraordinary how much posterior displacement of the tibia can be corrected by extension and firm elastic bandaging. If there is any degree of torsion, however, it is almost impossible to correct, even by operation.

It must be remembered that dorsal—*i.e.*, popliteal—displacement of the tibia occurs as a result of adhesions or ankylosis of the *patella* to the front of the condyles of the femur ; if there is such ankylosis the dorsal displacement can only be prevented taking place by use of a splint, which must be worn sometimes for years, until, in fact, sufficient other adhesions or ankylosis has taken place to neutralize the action of the hamstrings, *as the quadriceps is placed out of action* by the attachment of the patella.

In the hip, unless the displacement is quite recent, all that can be done is to prevent it becoming worse by the use of extension and finally a Thomas's KNEE splint worn, employing extension by strapping or webbing attached to the cross-bar beyond the foot-piece, so enabling the patient to get about on crutches without increase of the shortening.

It is but rarely a displaced hip is brought back and retained in the position of the acetabulum. The treatment entails prolonged confinement to bed with extension after the active disease has subsided.

OPERATIVE MEASURES.—It cannot be doubted that operations of a set nature are rapidly decreasing in frequency. It has been shown by experience that excisions generally, which aimed at removing all the diseased tissue in bone and soft structures, have not met with the success they should logically have attained.

With conservative measures, including even absolute rest and fixation, in the case of *all joints*, excluding possibly the knee, *better* results have been attained, and even in the knee results of both treatments are about equal. In future, I believe, in knee cases conservative measures will show far better results.

Operations are chiefly indicated when the general health demands rapid and complete relief from a grave lesion, when for instance there is :—

(1) Severe phthisis,

(2) Or other constitutional disease,

(3) Or there is such a faulty position that it must be corrected by operation.

(4) When it is anticipated the result of conservative measures will not be better or so good as operative, especially when the joint has been greatly distended by a large effusion.

(5) When there is incipient amyloid disease from prolonged suppuration.

(6) When the cure can be hastened in cases in which

time is an important element—*generally at the cost of much bone.*

The *modern operation is really one of arthrectomy*, i.e., *erasion*, and consists in removing all diseased synovial membrane, and gouging out all obvious foci of disease in the bones.

Complete layers of bone are not removed unless the whole extremity of the bone is diseased ; the *obvious* disease with a small amount of healthy surrounding bone is removed with the *gouge*, as the sharp spoon can never remove the whole of the infected bone.

The cavities thus formed are either allowed to fill with blood-clot or some form of *sterile* plastic material is introduced, such as—

Iodoform	10 per cent.
Paraffin wax	70 ,,
Sesame oil	20 ,,

Or iodoform paraffin alone.

In any case *immediate closure* of the wound must be carried out.

Whether a tube is inserted for twenty-four hours depends upon the amount of hæmorrhage and effusion likely to occur ; it should never be worn for longer than this time.

After the operation a sterile dressing is applied, and a firm flannel bandage over a thick layer of wool.

Whether a splint is worn in addition depends upon the amount of diseased tissue excised, and the predilection of the surgeon.

If he thinks a movable joint can be attained it will be wiser to do without a splint ; the big dressing and rest in bed on a pillow suffice.

Personally I advocate a Bier's bandage after twenty-four hours, for which purpose the dressing MUST be completely loosened.

With this object in view the incision should not be dressed with collodion.

True excisions are confined to the knee-joint. (See later.)

Amputation for tuberculosis is becoming one of the surgical rarities.

TUBERCULOSIS OF THE HIP.

Hip disease is the most frequent form of tuberculosis of the extremities; it is stated that 90 per cent. of the cases occur before puberty, between 2 and 13. 50 per cent. before the 10th year (Cheyne and Burghard). After 25 primary disease of the hip is very rare, but relapses in middle life are common.

The male sex is more liable to the disease than the female. This is stated to be due probably to the increased liability of males to injury from their more boisterous habits, and some authors assign a considerable importance to *phimosis* as an exciting factor.

The *mode of injury* conducing to the onset of tuberculosis. While any form of sprain suffices, it is particularly prone to follow falls on the trochanter or shocks, such as alighting on the feet with the legs abducted, as these are said to be liable to contuse the attachments of the round ligament.

In the hip is best seen the condition called caries sicca, wherein extensive rarefying osteitis with union of the femoral head and acetabulum occurs, or extensive absorption of the head and neck without pus formation, and accompanied generally by dense fibroid thickening of the soft tissues.

There is a considerable mass of evidence to show that active tuberculosis of the lungs is more apt to follow hip disease than other joints, and that its onset may coincide with or be followed by improvement in the disease affecting the hip.

Site.—It originates more frequently in the bone than the synovium, *i.e.*, any part of the neck, or the epiphysis of the head, particularly near the femoral attachment of the round ligament. The floor of the acetabulum is more rarely involved primarily. When it is diseased

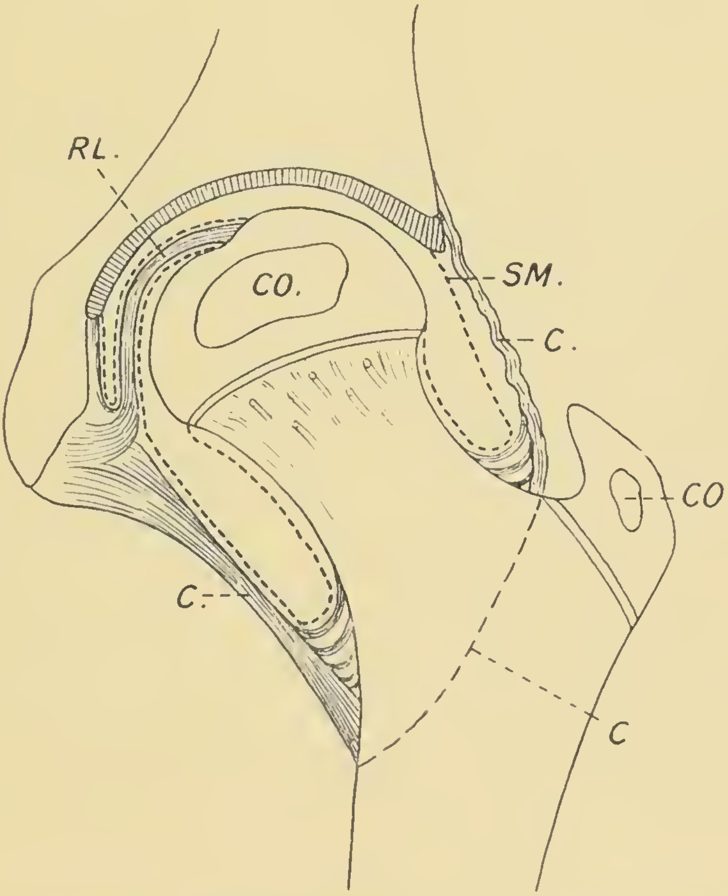

FIG. 48.—Section of hip, anterior view. *C.*, Capsule with the reflected fibres of Cooper : note, its attachment in front includes the whole neck (see figs. 51 and 52) ; *SM.*, synovial membrane ; *RL.*, round lig. ; *CO.*, centres of ossification.

it is generally in the cotyloid fossa where the round ligament is attached.

It may be involved secondarily from a tuberculous psoas bursa by continuity of the synovial membrane.

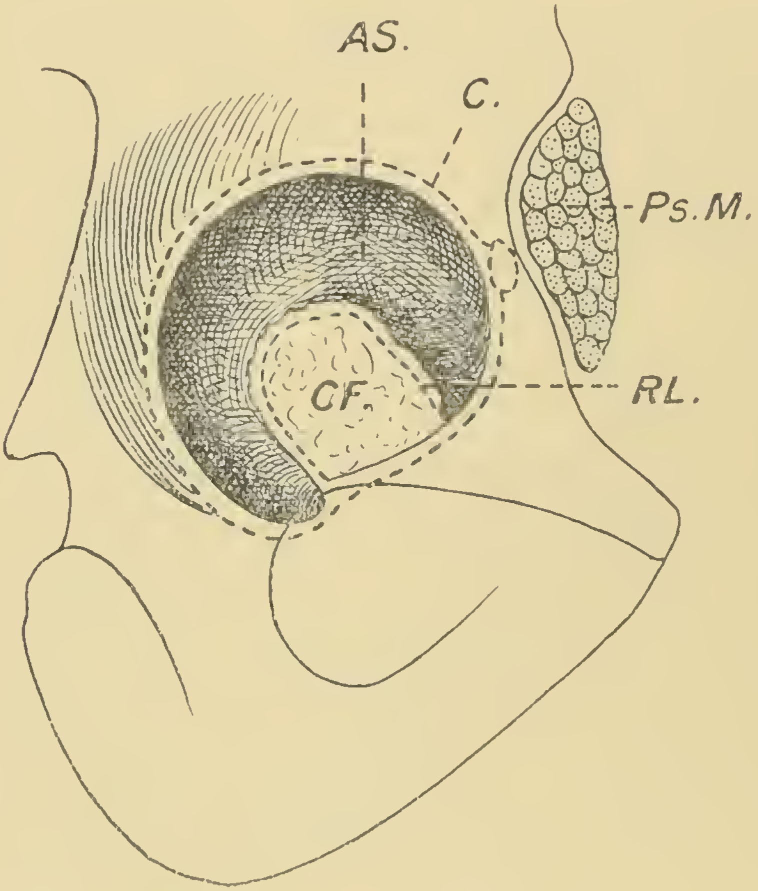

FIG. 49. *The acetabulum and psoas muscle.* *AS.*, acetabular fossa; *CF.*, in the cotyloid fossa: commonest site of origin of T.B. when primary; *RL.*, attachment of round ligament; *C.*, the capsule with communication with psoas bursa; *Ps.M.*, psoas muscle.

Progress and History.—While still confined to the femur, either as caries or in the form of an abscess, the symptoms are indefinite.

Sooner or later the disease extends to the surface, oftenest on its under aspect, and infects the joint, often producing sequestra at the same time, some of which are harder and denser than those generally found, when they consist of the outer shell of the neck.

When the joint is infected it frequently goes on to abscess formation, which readily becomes periarticular. This may extend in various directions, but it most frequently comes to the surface between the anterior superior spine and the line of the femoral artery, and next in frequency just in front of and below the great trochanter.

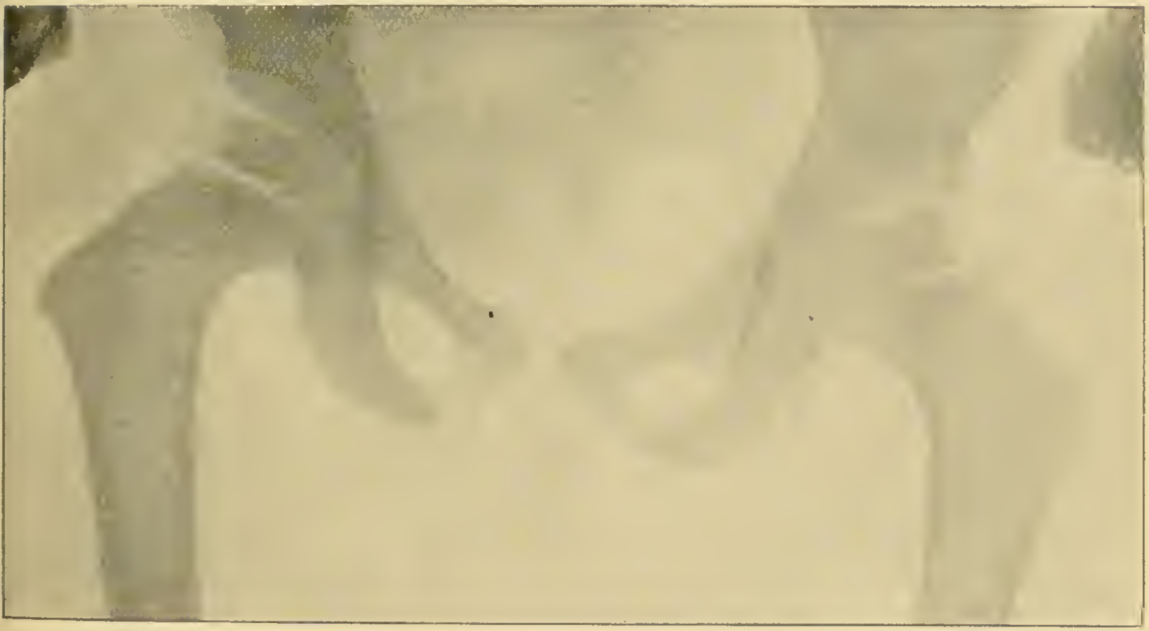

FIG. 50—A skiagram of primary tuberculosis of the floor of the left acetabulum.

However, it may follow many courses and find its way to the surface in the buttock, in the thigh, over the adductors or near the tuber ischii, or in front in Scarpa's triangle.

The abscess may gain access to the iliac fossa along the obturators or through the psoas bursa, and thence as an ascending infection in the muscles, and, finally point just above Poupart's, generally outside the line of the vessels.

It is said the disease chiefly gets into the iliac fossa and pelvis by perforating the floor of the acetabulum, but this is its least frequent course, as inside the pelvis the bone often becomes thickened by periostitis, as can be felt P.R.; however, it may form an abscess here. Breaking down of infected iliac glands may produce an iliac abscess, which therefore does not arise directly from the joint.

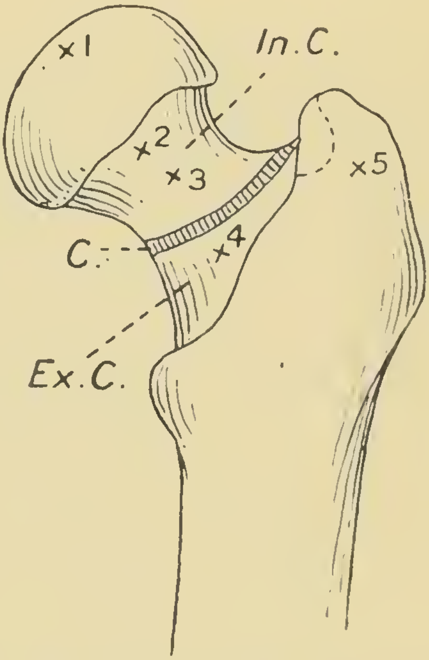

FIG. 51.—To show the sites of origin of T.B. of femur: Posterior view. *C.*, attachment of capsule; *In.C.*, intra-capsular neck; *Ex.C.*, extra-capsular neck; X^1, X^2, X^3, intra-capsular foci; X^4, extra-capsular focus with probable extra-capsular abscess; X^5, great trochanter focus; ditto abscess.

The position of the sinuses is important, in so far as they give rise to wrong diagnoses or difficulties in treatment when they exist at unusual sites or at a distance from the joint.

When the disease begins in the femoral epiphysis exfoliation of the cartilage is almost certain, and is an important complication, as it results in starting pains, and increases the pain generally and produces rapid deterioration of the general health, besides interfering greatly with treatment.

The *cartilage* may be eroded by the synovial extension in the usual manner (see p. 21).

When the disease begins in the acetabulum it rapidly tends to undermine and set free the Y-shaped cartilage, and even cause dissociation of the bones with consequent deformity of the cavity. The granulation tissue which forms therein tends also to pathological or even true dislocation by forcing the head of the femur out of the acetabulum.

Abscess in the obturator internus may arise and spread upwards into the iliac fossa, or burrow downwards and open along the structures arising from the descending pubic and ischial rami, or burst through the rectum, vagina, or bladder, or form an ischio-rectal abscess.

Pathological displacement occurs almost always postero-superiorly, because all pressure, whether by spasm of the muscles or by weight transmission, is expended on this portion of the acetabulum; it is predisposed to because the capsule is much weaker here than in front.

True dislocation, either backwards or forwards, may occur when the capsule and ligaments are much softened and weakened by the inflammation, and the acetabulum filled by granulation tissue, but generally the *displacement* follows on absorption of the posterior lip of the acetabulum. The carious bone is pressed upon by the head of the femur, it is rapidly absorbed or breaks down and the head tends to slip on to the dorsum ilii; in the periphery of the disease subperiosteal bone formation takes place (see p. 22), and thus a sort of new acetabulum is formed which limits the displacement, the new bone is absorbed in its turn, and so the head travels further on to the dorsum ilii (travelling acetabulum).

For the same reason in many instances the head of the femur disappears by absorption, and the neck, more or less complete, articulates with or unites to the os innominatum; shortening of the limb under either condition is inevitable.

From what has been briefly stated it is obvious that both pathological displacement and *grave* absorption of the head and neck of the femur are largely PREVENTIBLE (see fig. 57).

Extensive burrowing of abscesses also indicates neglect and chronicity, and should be prevented by early interference by aspiration or incision.

Necrosis and separation of the head of the femur is not frequent unless the joint has been severely infected by pyogenic micro-organisms, although the whole of the cartilage covering the head may be completely exfoliated by the tuberculous process alone.

When the neck, *close to the trochanters*, is involved the disease may not open into the joint but extend outside the capsule, and abscesses, not communicating with the joint, may form. Peri-articular adhesions with crippling may result, however.

Likewise, tuberculosis commencing in the *epiphysis* of the great trochanter usually forms an abscess which bursts in a peri-articular situation, but it may extend inwards and infect the joint.

The disease when affecting the hip may be of such varying intensity that it is difficult to give a description to fit all cases, consequently many classifications occur. Thus degrees of disease may occur :

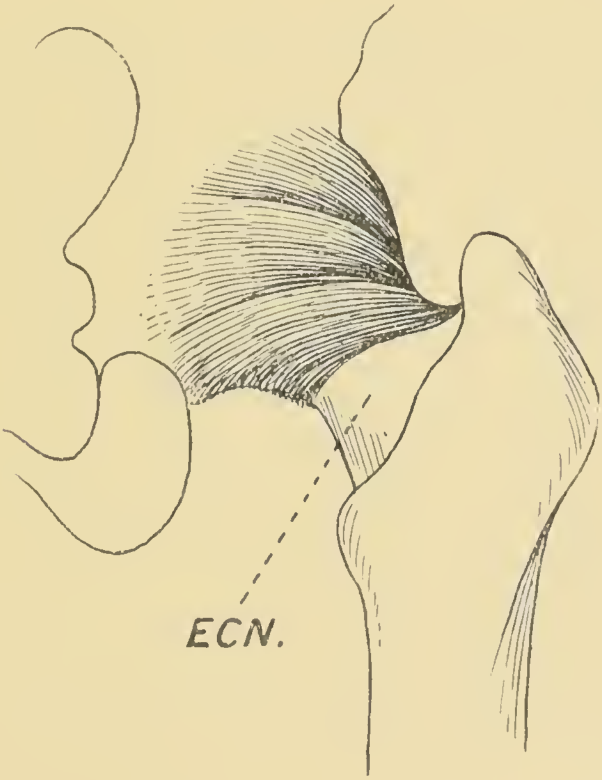

FIG. 52.—The hip Joint from the back showing the capsule and the large area of the neck which lies outside the capsule, *ECN*.

(1) Ranging *from* an acute miliary tuberculosis, *i.e.*, multiple foci, which affects synovial membrane or bone, especially the latter, and goes on to rapid destruction of the joint.

(2) *To* a chronic type with marked fibrosis of the soft structures, or dry caries with great absorption of bone but with ameliorated symptoms. .

The oldest *clinical* classification is based upon the obvious gross changes indicated by the—

(1) Stage of onset or localized disease.

(2) Stage with apparent lengthening.

(3) Stage with real shortening.

A description of a typical case of moderate severity going through the various stages will be given. As the primary infection is most common in bone it will be wiser to assume a bony focus throughout. When the synovial membrane is involved the amount of effusion is in inverse ratio to the amount of granulation tissue; if a considerable amount of synovial membrane is *unaltered* more effusion is likely to occur and to be of the serous type; and whereas, if there is rapid conversion into granulation tissue the fluid effused is less, *until* rapid breaking down and pus formation sets in, which is frequently due to an added infection, either hæmatogenous or by a sinus. This probably holds good for all joints.

Clinical Signs and Symptoms.—Two great stages may be considered:—

(1) When the disease is confined to the head or neck of the femur.

(2) When the joint is involved.

First Stage, i.e., DISEASE CONFINED TO BONE.

In addition to the premonitory symptoms common to all joints, especially tenderness (see page 294), certain special points must be recognized in hip cases.

(1) *Pain* referred to the knee on the inner and anterior aspect.

(2) Rapid atrophy of the muscles of the thigh and buttock.

(3) The *posture* associated with and resulting in the *apparent* lengthening is the position of—

Flexion,
Abduction,
External rotation.

(4) *Apparent* lengthening on the diseased side.

(5) *A limp.*

The Posture.—It is difficult to explain the posture in the stages where *no* effusion exists, since it is usually stated to be the position of greatest *capacity* and therefore greatest ease. However, even in the early stages it is assumed, probably from reflex muscular spasm.

The apparent lengthening is due to the pelvis being tilted down on this side and somewhat rotated forwards. Thus if a person stands upright and abducts and everts one leg the foot is soon raised an inch or more above the floor ; in order to reach the floor in this attitude the body must be tilted over to this side and forwards, *i.e.*, the pelvic end of the limb must be lowered, which means that the pelvis must be tilted downwards and forwards.

If this tilt is maintained it becomes irksome, so a curvature of the dorsi-lumbar spine develops, this is flexed forwards (lordosis) ; and soon the upper dorsal region curves to compensate for the laterally inclined pelvis, and consequently a curve in the lumbar region occurs with its concavity towards the sound limb (scoliosis).

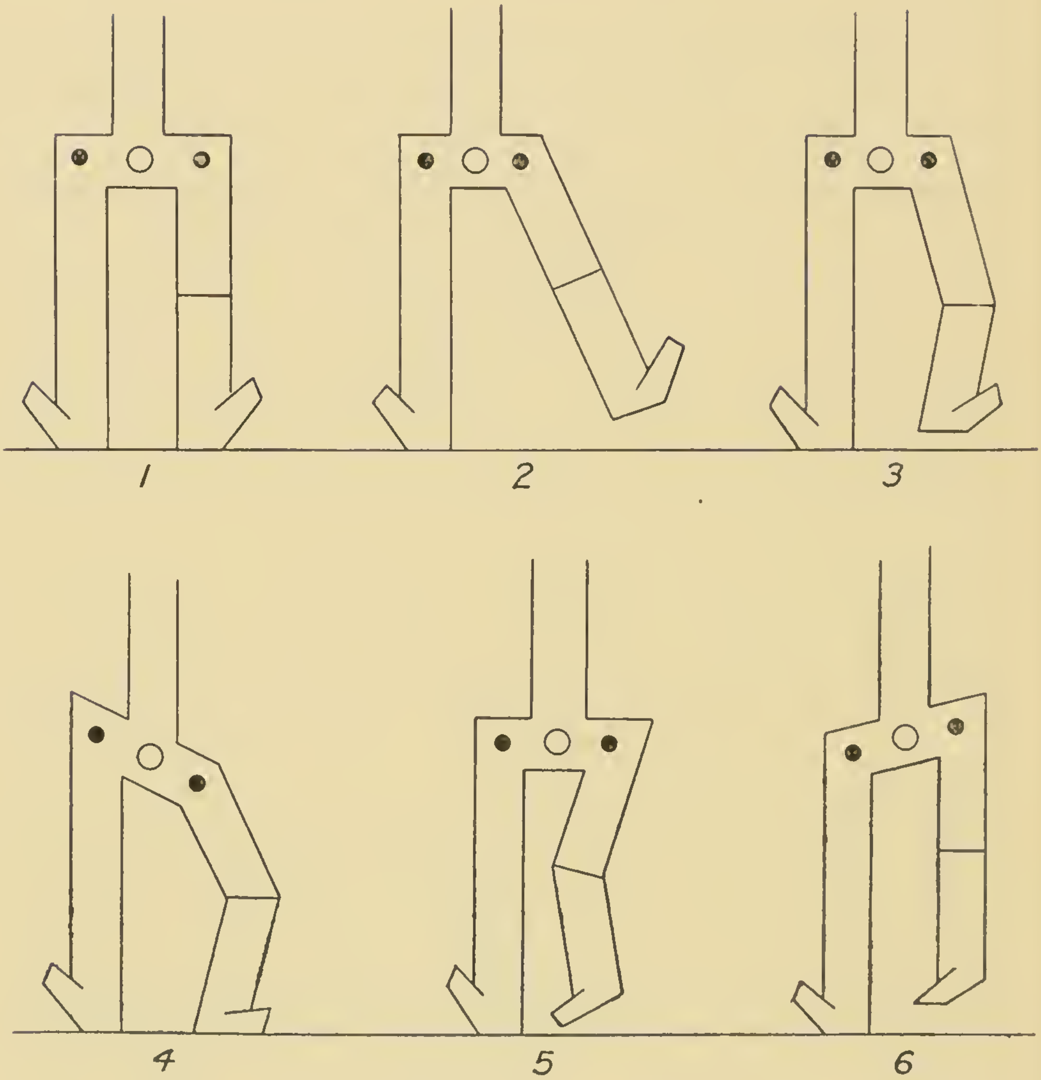

FIG. 53.—(1) A cardboard mannikin representing the spine, pelvis and lower limbs. (2) At the onset of Tuberculosis in the left hip, the limb becomes flexed, abducted and rotated outwards. (3) The deformity maintained, but the knee is flexed, thus still further raising the foot above the ground. (4) To enable the foot to reach the ground the left side of the pelvis is tilted downwards. (5) The disease represented at a later intermediate stage, the flexion is maintained but adduction and internal rotation has taken place. At some time during this transition, the anterior superior spines must again become horizontal, as represented. (6) In the final stage, when the patient stands quite upright without any compensatory spinal curvature, the pelvis on the diseased side is greatly elevated, and the foot much raised above the ground.

The greater the spinal compensation curves the less distorted appears the limb, hence its malposition may be hidden, *until the patient lies down*, when the pronounced forward curve of the spine shows as a *lordosis*.

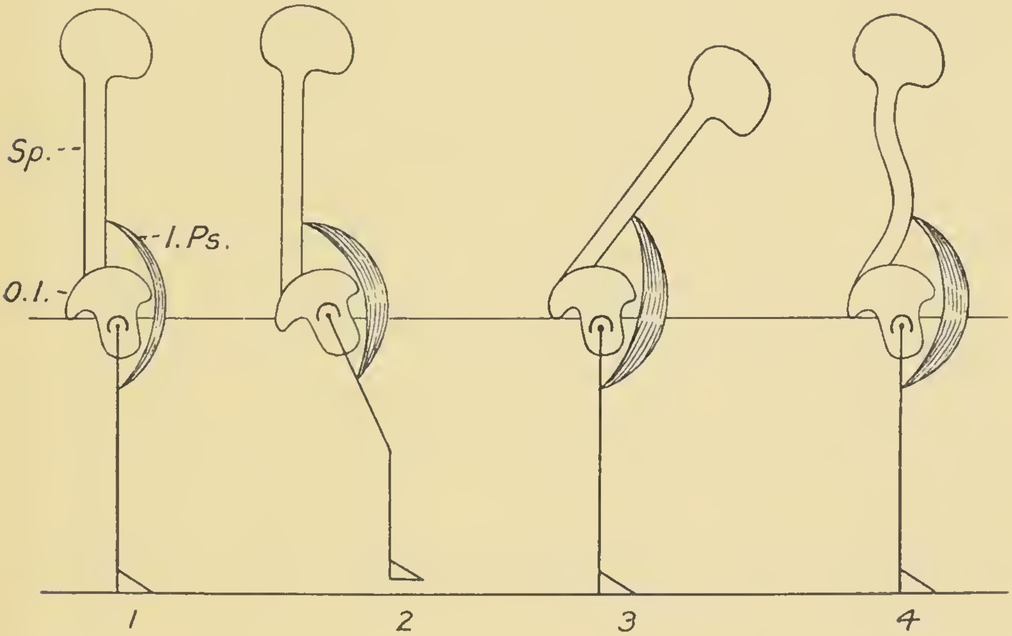

FIG. 54.—(1) Represents a lateral view of the body. (2) The hip is flexed by ilio-psoas contraction, and the pelvis tilted, the foot is raised above the level of the ground. (3) To enable the foot to reach the ground the spine is bent forwards, but as this becomes irksome and is inconvenient, the upper part of the spine is brought into the perpendicular by the devolopment of compensatory curves; hence lordosis is produced. (4) In the 4th diagram the flexion at the hip is hidden by the lordosis now present. Note the contracted ilio-psoas.

An X-ray examination will reveal the caries in the femur at a very early stage, and the beginning involvement of the joint is also made manifest by blurring of the cavity.

Second Stage, i.e., WHEN THE JOINT IS INVOLVED, BUT ABSCESS NOT FORMED.

As before stated, this may be a very acute process, or a more insidious one. The *signs and symptoms* depend upon the exact pathological condition.

First, as to whether there is only synovial disease, *i.e.*, pulpy granulation tissue; secondly, whether ulceration of cartilage and acetabular disease is present?

The typical signs and symptoms of the disease are, in addition to the history of the child generally and the possibility of a sprain or fall:—

The insidious onset of *pain* in the hip or knee, or both, and gradual development of a *limp*, while the child becomes listless and loses its activity.

Atrophy.—There is obvious wasting of the thigh, abductor and gluteal muscles, the prominence of the buttock is much reduced and the fold is less marked. Wasting of the thigh is easily measured by taking points on each limb equidistant from the abductor tubercle or upper border of the patella. There is no evidence of swelling, induration, redness or trauma. The *posture* of the limb is that it is always flexed, abducted and everted; the flexion may be masked by lordosis, which is then apparent and the abduction hidden by the adduction assumed by the sound limb; but the *eversion remains obvious.* It can be measured and demonstrated by marking the outline of the two patellæ aud observing that the diseased one looks more laterally than the normal.

Observe that the patient stands with the *weight of the body on the sound limb* and very frequently the affected limb is advanced, the patient naturally protecting it by assuming the stand-at-ease posture.

The antero-superior spine on the affected side at this stage is more anterior than the sound one.

On palpation, spasm of the muscles is felt.

If the thigh is gently palpated certain muscles feel more tense and firm than on the sound side, and on any attempt at movement of the limb they immediately start into a very rigid spasmodic condition. They are persistently contracted while the patient is standing.

There is frequently some *spasm of the erector spinæ* in the lumbar region, which is apt to make one consider the question of spinal caries.

In the region of the hip joint or about the trochanter, it is usual on comparing the two sides to feel marked rigidity, but usually no thickening *in the earlier stages.* This is felt for by firmly grasping the trochanter with the fingers pressed into the hollow behind it, and the thumb in front.

The iliac fossa should always be palpated as in some cases definite enlargement of the iliac glands situated above Poupart's is evident, or a sense of deep induration felt in the earlier stages, while tenderness is generally present. Also increased fulness in Scarpa's triangle may be felt.

The *atrophy* of the muscles is also made apparent on palpation.

Increased heat may not be distinguished, but not infrequently it is possible to feel a slight increase in the temperature over the trochanteric region.

Jarring the joint by firmly striking the heel may or may not produce pain; in a later state it *always* produces pain, and often of an intense degree.

When the disease is in the neck of the femur, tapping the trochanter will generally elicit discomfort or even pain, and under these conditions *tenderness* on firm pressure on and in front or behind the bone will be complained of. **Tenderness is a sign of very great value in all bone lesions of an inflammatory nature.**

The Limitation of Movement.

One of the very easiest tests to apply for this is to make the patient sit in the tailor's or Turkish attitude, when it will be found that the affected limb cannot be put into such a good attitude as the sound one, the knee keeps at a higher level and cannot be "flattened" down, nor can the heel be brought as close to the buttock as the sound heel.

Often in the earlier stages the limitation of movement is hidden, as it only becomes manifest during *extreme ranges*, but the tailor's attitude will always make it evident.

Also in the earlier stages movement within a moderate range may not increase the pain in the knee or hip.

Measurement from the antero-superior spines to the tip or base of the malleoli, while the patient lies down with the sound limb *abducted* to the same position as the affected one, shows that there is no *real* increase in length.

As the disease progresses, and especially when the cartilages are involved, certain pronounced symptoms arise. These are:—

(1) Starting pains at night.

(2) The sensation of creaking or grating on movement.

And if breaking down of the granulation tissue is proceeding—

(3) The evidence of abscess formation.

All the symptoms already mentioned increase and become more pronounced; *lameness* to a serious degree occurs.

Pain is now constant both in the hip and knee, and all movements aggravate it, while the excruciating pain felt when the patient is about to fall asleep leads to loss of sleep and rapid deterioration of the general condition.

Starting or night pains are not absolutely diagnostic of destruction of cartilage and exposure of bone, as they may be produced also by friction of acutely inflamed synovial membrane or the round ligament. Thus when relaxation of the muscles hitherto rigidly fixing the joint occurs, at the moment the patient is about to fall asleep, the opposed surfaces fall apart and are suddenly rubbed together, hence exciting severe pain. The immediate *reflex contraction of the muscles* which takes place to refix the joint again results in friction, probably the more violent of the two.

The *wasting of the muscles* enables the trochanter and joint region to be more easily palpated, and thickening of and about the trochanter is often felt, while *œdema* and increased *tenderness* and *induration* can readily be made out. Increase in the temperature of the skin may also be apparent.

The *posture* is either that of more exaggerated flexion, abduction, and eversion, or else the flexion is increased while *adduction* and *inversion* is being assumed (see fig. 53).

The lordosis becomes marked, and there is not infrequently a definite scoliosis, but the curve is reversed, *i.e., concave to the diseased side,* if the position of inversion of the femur is present. During this intermediate condition a stage of apparent shortening, due to the reverse conditions of the pelvis, may precede the real shortening, with abduction of the sound limb.

The inversion and adduction always indicate a severe degree of destruction in the joint, usually associated with considerable shortening and contraction of the ileo- and pubo-femoral ligaments.

The *limitation of movement* is now pronounced, and even without there being any actual adhesion or ankylosis between the femur and acetabulum, when the limb is moved the joint is rigidly fixed, and the pelvis tilts according to the attempted movements. If the pelvis is firmly grasped to prevent this tilting, no movements of the limb now take place, so great is the spasm of the muscles, and the patient cannot tolerate the efforts to bring them about.

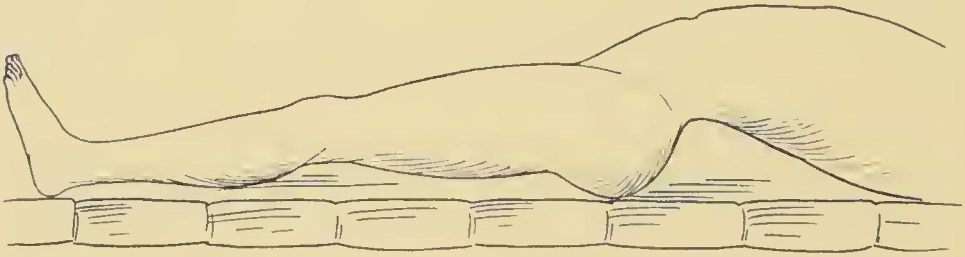

Fig. 55.—Shows the lordosis in advanced hip disease.

Grating on movement is but rarely felt, and generally in the acute cases of the ulcerative type only. Grave exposure of bone may be present, but if there is exuberant granulation tissue it may prevent the two surfaces rubbing together, or they do not oppose. Usually, of course, it is impossible to move the limb sufficiently to elicit the grating. In other cases, the slightest movement produces it.

Jarring by tapping the heel or trochanter now produces intense pain.

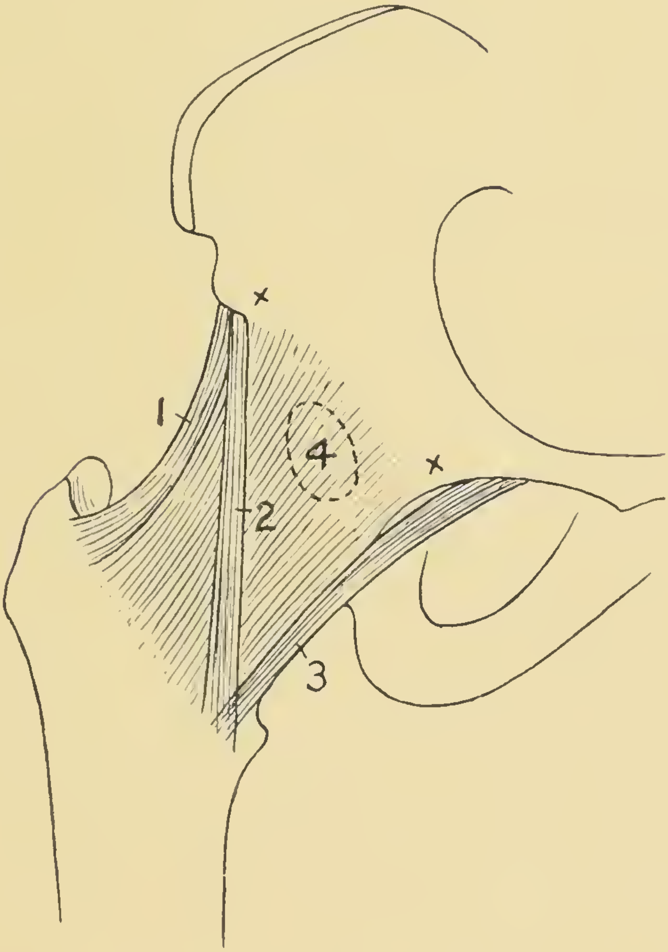

FIG. 56.—The capsule and ligaments of the hip, front view. 1, the ilio-trochanteric limb of Bigelow's **Y** ligament; 2, its ilio-femoral limb; 3, the pubo-femoral ligament; 4, communication with psoas bursa when present; x, x, position of ilio-psoas muscle.

When abscess formation occurs, pain of a more throbbing or wearying nature occurs. The trochanteric region, the front of the thigh in Scarpa's triangle and often the whole gluteal region become full, tense and may be fluctuating.

When the abscess bursts through the capsule, relief of symptoms may take place, and a subcutaneous swelling soon appears, which is hot, red, tender, œdematous and fluctuating. It may burrow extensively amongst the muscles and, following the fasciæ, point at a distance from the joint.

The *general condition* becomes so much worse, the temperature, sweats, the hectic appearance and the other symptoms of septic poisoning betray the pus formation.

During the final stages actual shortening of the limb occurs from erosion of bone, with or without pathological dislocation. The flexion, adduction and inversion become pronounced and the pelvis is *elevated on the diseased side.* The scoliosis is now marked.

If abscess has not developed previously it is very prone to occur now, or, if present, to discharge through one or more orifices. When firm ankylosis occurs, or an abscess discharges, symptoms ameliorate considerably, and the violent starting pains especially may entirely disappear. The general condition usually improves and recovery may occur.

Sinuses may persist for many years while the patient is following an active career, but exacerbations of symptoms through collection of pus from obstruction to its exit takes place from time to time.

OBSERVATIONS ON CERTAIN IMPORTANT POINTS.

The *shortening* is partly due to the posture the femur is pulled into by contraction of ligaments and fibrous tissue, which also makes it permanent; but the important cause of shortening is the actual loss of bone and cartilage, either by

(*a*) Dry caries with osseous union between femur and acetabulum ;

(*b*) By erosion and absorption of bone with abscess formation ;

(*c*) By separation of the epiphysis forming the head of the femur.

(*d*) By pathological dislocation with the formation of a travelling acetabulum ; or other displacements.

(*e*) Also by *interstitial* absorption in the neck and loss of growth.

The *adduction and inversion* which now accompanies the flexion is due to various causes, which it is of very little real importance to discuss, beyond this ; that in this disease, as in all joint lesions, *the deformity is largely preventable by attention to treatment.* Once real shortening has taken place in a young subject, it must be remembered that it may relatively increase by the disparity in growth of the two limbs and may become very marked in after life.

In older subjects, or in those in whom the shortening remains comparatively little, lengthening of the limb may be secured by operation on the shaft of the femur in suitable cases.

The *pain* in the knee is impossible to localize, it is situated over the inner and anterior aspect of the lower part of the femur. It is not confined to a small spot but spreads over a considerable area. The pain in the hip is more localized.

Both in the early stages intermit ; they may quite disappear for a short period, then recur. The pain is generally aggravated by exertion and therefore usually becomes more pronounced towards the latter part of the day, or after unusual efforts at exercise it may recur in a more acute degree.

In the morning it may be absent. It occasionally happens that pain in regard to the actual amount of disease present is quite disproportionately slight.

The *limp* in so far as it is due to pain reacts in the same way. Both symptoms increase in persistence and degree and finally become very marked.

The *onset of starting* pains at night is a serious symptom, which is often the occasion for first calling in the doctor. Its intensity and ill-effects are pronounced, but are greatly modified by applying extension to the limb to overcome the muscular spasm which is the real exciting cause.

Extension as generally applied is too severe, the weights used are too great; it is persistent mild traction which is called for. Not infrequently extension, after it overcomes the muscular spasm, *produces* pain, if the weight is sufficiently great to stretch the soft tissues, and must then be discontinued or greatly modified.

The *spasm and atrophy* of muscles is early and marked. The atrophy is unquestionably increased by disuse. At first this is confined to the muscles above the knee, but at a later stage the calf muscles also atrophy and become soft and flaccid.

Abscess formation is present in about half the number of cases, but this frequency can be much reduced by early treatment and dieting on a generous scale.

The *caries sicca* type of disease is often conduced to by immobilization alone, *i.e.*, without extension. It must be remembered that if extension is not maintained great shortening is apt to be produced.

SUPPURATION IS RARELY OBSERVED EARLY, generally not until six months after the onset of symptoms.

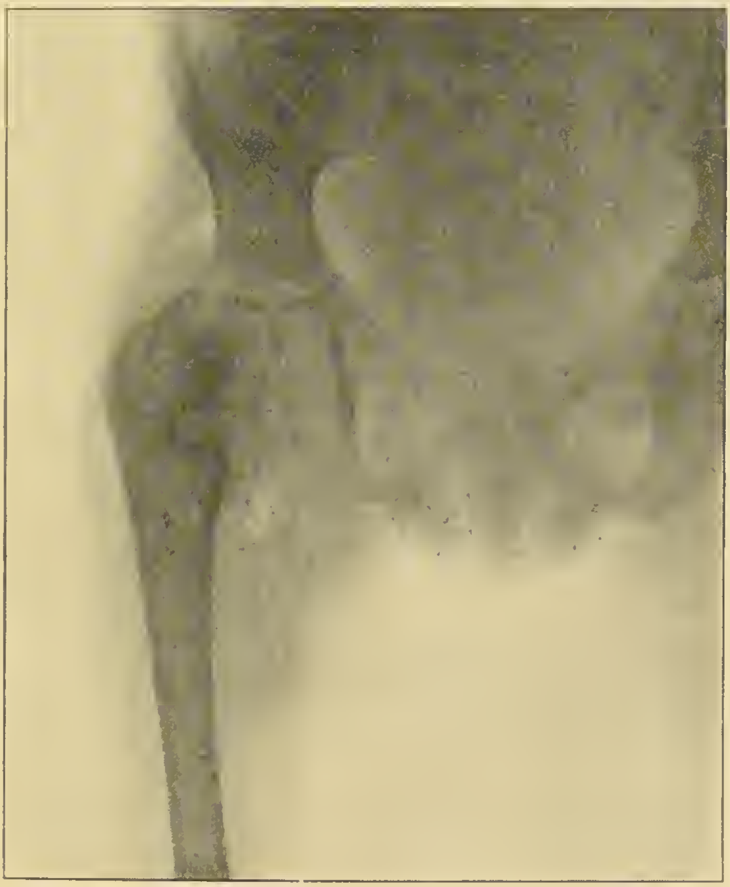

FIG. 57.—Shows the neck of the femur crushed in. As a result of the weakening of the bone by extensive bony tuberculosis the neck has been unable to sustain the tension put upon it by the muscular and fibrous tissue contraction, or possibly by attempts to walk upon the limb. Stage of actual shortening. By correct treatment this calamity can usually be avoided.

A considerable amount of caseous material can be and often is absorbed.

Frequent and careful examination is necessary to detect breaking down in an early stage, before the abscesses have assumed a large size and burrowed a considerable distance along the fascial planes (see General, p. 282).

When the *acetabulum* is involved abscess is said to be frequent and early, and opens most often near the pubis, either below or above Poupart's ligament. Sinuses may exist on any part of the buttocks or thigh in neglected cases.

When an abscess appears, a firm, tense swelling forms with increase of local pain ; œdema and bogginess develop, then the skin becomes inflamed, the veins show up and an abnormal swelling is manifest, while if the process is a slow one the whole buttock area may consist of a fluctuating swelling deep to the muscles without any sign of skin involvement.

In some cases an abscess may suddenly burst without its presence having been discovered, generally from want of examination. In other cases exacerbations of pain have taken place from time to time without obvious pus formation, and so repeated examinations have been abandoned, thus finally leading to the surprise of a sudden discharge of pus.

The *glands* in the iliac fossa are often *early* infected and break down to form abscesses.

THE GENERAL CONDITION varies greatly and depends upon the previous state of health of the patient, upon the degree of pain, and especially the nocturnal starting ; also whether rapid breaking-down or sclerosis is taking place in the joint. The worst condition is associated with mixed infections and pyogenic processes.

All extensions of disease are indicated by some exacerbation of general symptoms.

The *fever* which is always associated with the disease may be quite moderate or of a marked remitting type; there may be severe night sweats and exhaustion, but the extreme ill signs so long associated with hip disease are now far less frequently seen.

When an abscess opens, a change for the better occurs at first in all cases. This is maintained if rigid ASEPSIS and *absence* of packing with gauze or tubes is carried out, but the contrary takes place if the wound is plugged, &c.

The most important individual unfavourable set of symptoms is concerned with the digestive tract; if appetite fails and nourishment cannot be taken, the outlook is bad and the general state suffers accordingly. Also want of sleep is another unfavourable symptom.

Recovery depends upon a healthy digestive tract, the absence of septic infections of the mouth and nose, &c., and upon sound local treatment; these act and react directly upon one another. Remissions of the disease occur, leading also to an improved general condition, and then recurrence may set in and the patient be again severely ill.

EXAMINATION OF THE PATIENT.

If the patient is a child or nervous youth, be very gentle and carry out all movements first on the SOUND limb to show that they are harmless, and thus gain the patient's confidence and help.

The most important signs of tuberculosis by which an early diagnosis can be made depends upon the posture and the limitation of movements.

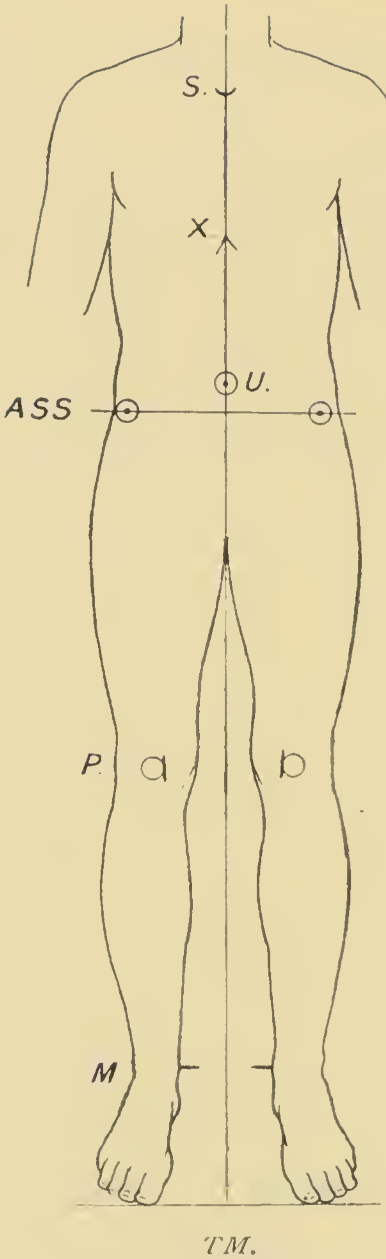

FIG. 58.

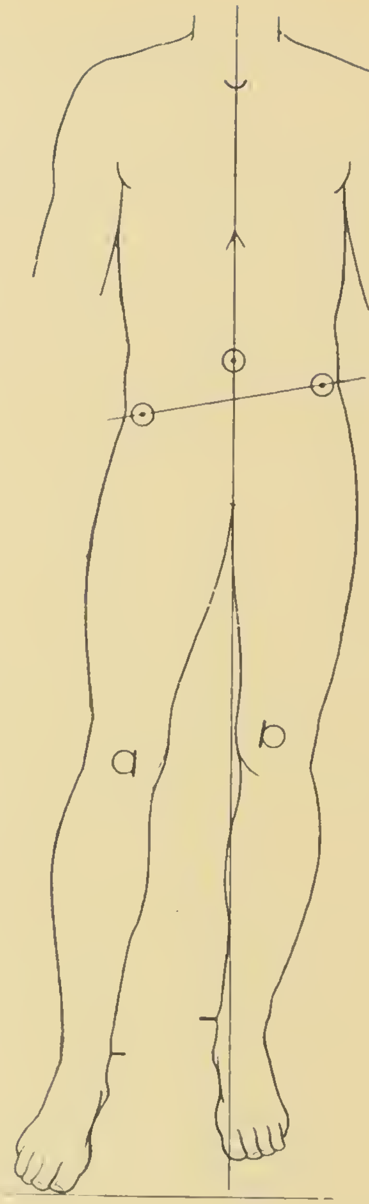

FIG. 59.

TO ILLUSTRATE THE METHOD OF MEASURING AND DEMONSTRATING THE ABDUCTION AND ADDUCTION IN HIP DISEASE.

FIG. 58.—*S.*, suprasternal notch ; *X*, epigastric fossa ; *U*, umbilicus ; *ASS*, ant. sup. iliac spines ; *P*, patella ; *M*, malleolus ; TM, a tape measure carried in the line of the suprasternal notch, epigastric fossa, umbilicus and symphisis pubis (not shown) beyond the feet. These landmarks should be marked out carefully and clearly before any measurements are attempted. Also a line should be drawn connecting the two ant. sup. spines. Note the symmetry of the lower limbs with regard to the tape measure, the malleoli are about 1 in. from the tape.

FIG. 59.—At the onset of TB. in the right hip, the limb is flexed, abducted and rotated outwards, hence the rt. ant. sup. spine is depressed, consequently the diseased limb *appears* lengthened. Observe the sound (left) limb is *adducted* beyond the tape measure so as to be parellel with the diseased limb, the real extent of abduction is masked thereby (see fig. 60).

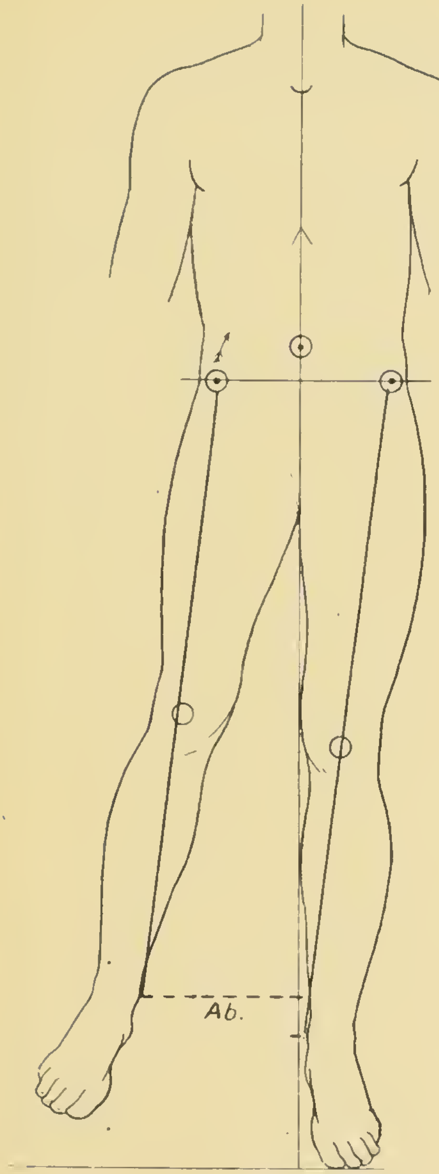

FIG. 60.

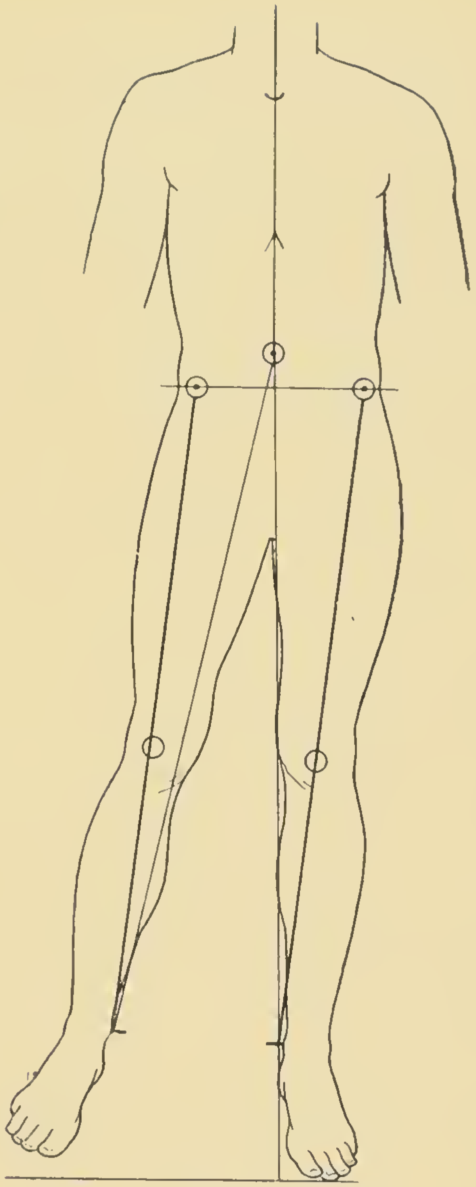

FIG. 61.

FIG. 60.—When the deformity is maintained by contracture of the soft structures or by bony ankylosis, the true amount of abduction is measured thus: The sound limb is placed in its normal position, *i.e.*, with the malleolus 1 in. to the left of the tape measure, the diseased limb is then abducted *until the two ant. sup. spines are horizontal*, the arrow marks the direction of movement of the right *ASS*. The distance of the right malleolus from the tape measure gives an index for record and future comparison.

FIG. 61.—There are two measurements of length in hip disease, one the actual bone-shortening, the other apparent or practical from the point of view of walking. The actual bone-shortening is measured from the ant. sup. spines to the malleoli *when the limbs have been placed as described in par.* 3 (also more correctly by Bryant's triangle, see fig. 64), while the practical or apparent is measured from the umbilicus to the malleoli and the two sides compared.

Note the diagrams do not give the actual changes, they are incorrect as regards scale.

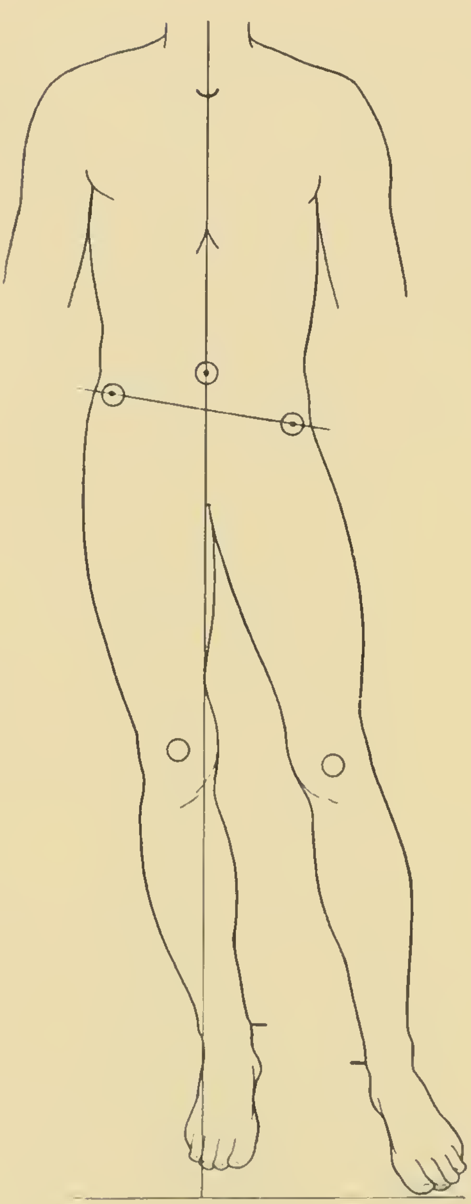

FIG. 62.

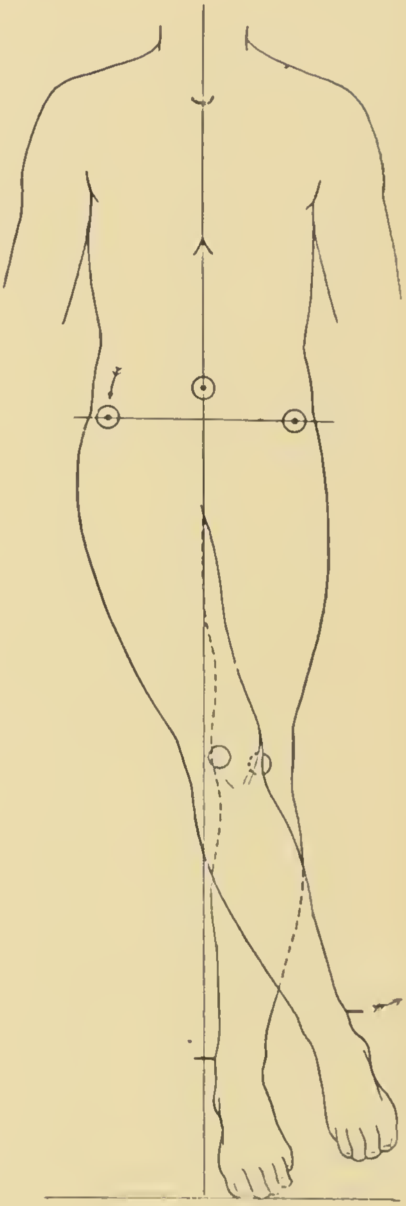

FIG. 63.

FIG. 62.—When there is actual bone absorption, or displacement, and effective treatment has not been used, flexion persists, but *adduction and internal rotation* occur, the *ant. sup.* spine on the affected side is elevated, and the sound limb (left) is abducted, so making the limbs parallel. Here again the true degree of adduction is hidden (see fig. 63).

FIG. 63.—To demonstrate the real amount of adduction: The sound limb (left) is placed in its normal position 1 in. to the left of the tape measure, the affected limb is then adducted *until the two ant. sup. spines are horizontal*, when this is effected the distance of the ext. malleolus from the tape measure is taken. In this position also the two measurements for length (see fig. 61) must be taken.

When the patient is placed on his back on a flat, firm couch or mattress, the whole body should be exposed, and identical spots on the two anterior superior spines and the two trochanters, as well as on the malleoli, also the position of the adductor tubercles, should be clearly marked on the skin, *before any measurements are taken.*

The amount of lordosis is seen and can be felt by passing the hand under the loin.

To show the Abduction.

The two limbs are placed *apparently* parallel with one another, then a rigid rod or a tape should be laid along the body in the line of the episternal notch,
the umbilicus,
the symphysis pubis,
and continued beyond the feet in this line, when the abduction of the affected limb and adduction of the sound one become obvious.

If the marked positions on the anterior superior spines be connected by a line or tape, this is observed not to be at right angles to the vertical, showing that one, the affected side, is lower than the normal.

A depressed anterior superior spine therefore indicates abduction and an elevated one shows adduction. If the affected limb is so moved that the two spines are made level, the position assumed by the diseased limb when this is attained will give the true measure of the abduction or adduction.

To find the amount of Shortening.

If Bryant's triangle is marked out on both sides with the limbs only *apparently* parallel, it will be seen that the base line is shortened on the diseased side, showing the great trochanter is *apparently* raised; this is not actually the case in the early stage, but is due to the abduction. It may be neutralized by the flexion to some extent.

Therefore, if possible, the limbs must be placed *actually* symmetrical, *i.e.*, both *equally* abducted, before Bryant's triangle is marked out.

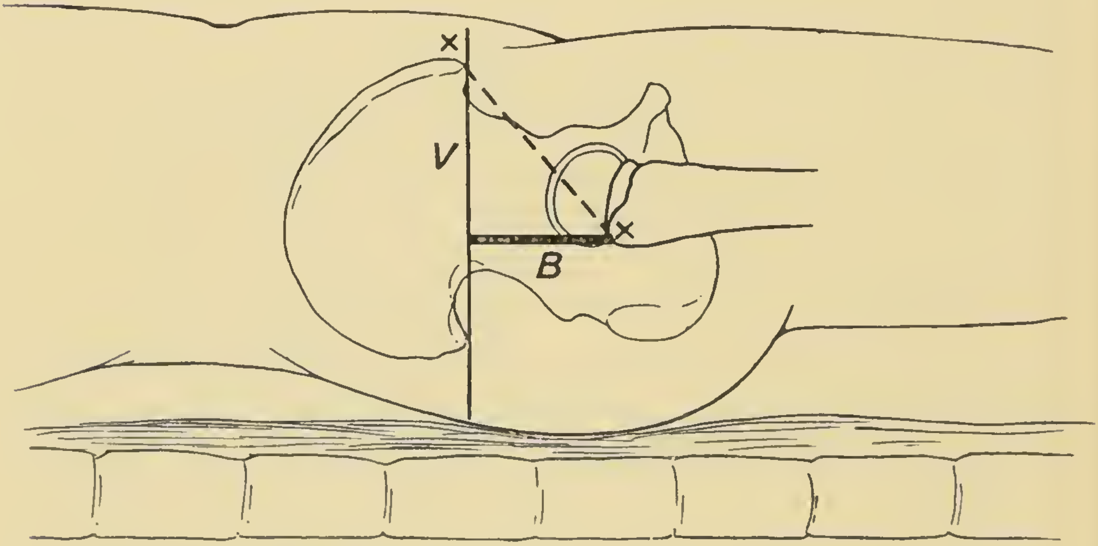

Fig. 64.—To illustrate Bryant's triangle. *V*, the vertical from X, the ant. sup. spine ; *B*, joins vertical and tip of great trochanter X. The dotted side is unnecessary.

With the patient lying flat on his back, place a tape at the anterior-superior spine and drop it vertically on to the couch; the position of the edge of the tape is marked on the skin of the buttock.

From this line another is drawn at right angles to it, to the mark on the great trochanter. *This line* is compared on the two sides, and it is seen the one on the affected side is shortened if there is any real absorption or erosion of bone or cartilage, or a displacement exists.

(It is unnecessary to complete the triangle by drawing the third line from the anterior-superior spine to the mark of the great trochanter ; it serves no useful purpose.)

This elevation of the trochanter becomes an actual one in the cases where the head of the femur and the acetabulum are eroded, *i.e.*, the later stages of tuberculosis. It is also present in coxa vara,
dorsal dislocation,
congenital displacement,
some impacted fractures.

But in the latter conditions the distance of the trochanter from the mid-line is diminished, whereas in early tubercular disease it is not different to the sound side *when the sound limb is abducted to a similar degree, i.e.*, when the limbs are put in identical positions.

This test is called *Morris's bitrochanteric test*, and to be of any value must be measured accurately with a proper instrument.

The amount of flexion is demonstrated by getting rid of the lordosis.

Stand on the healthy side and grasp the condyles of the sound femur. Place one hand under the lumbar spines, now flex the femur until the spines of the vertebræ rest on the palm, then withdraw the hand and the interval previously present under the loin will be found to have disappeared, and the affected limb will have assumed a position of *flexion*. The vertical height of the centre of the affected ham will give a definite measurement by which to indicate the flexion.

A second way is to grasp the affected ankle and raise the whole limb by flexing the hip until the lordosis disappears ; then the vertical height of the ankle above the couch should be taken.

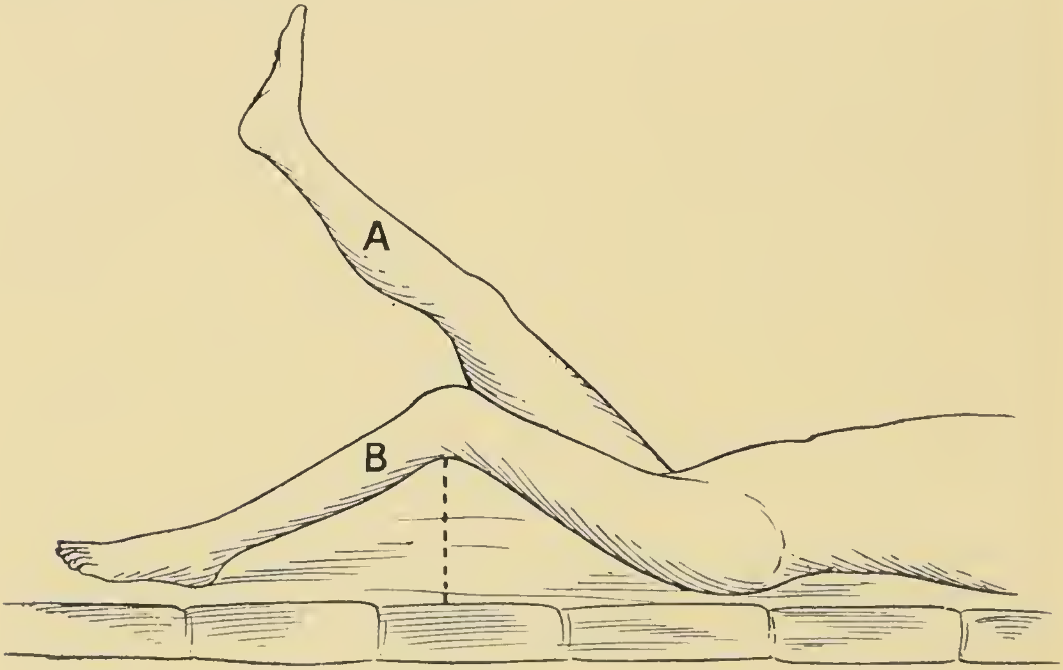

Fig. 65.

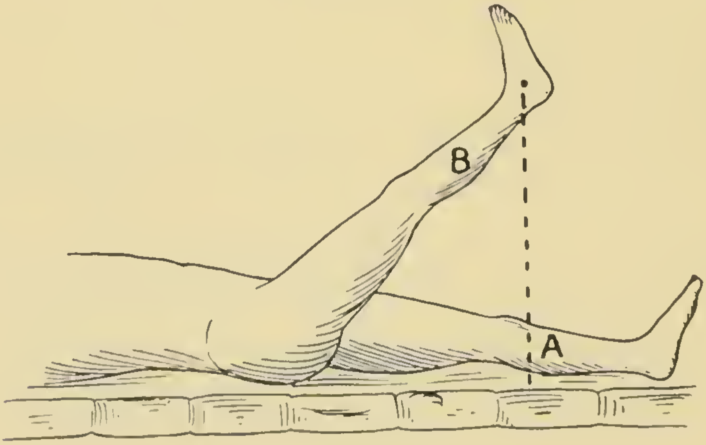

Fig. 66.

Other authorities carry out both manœuvres with the affected limb and employ special indices to give the angle of flexion.

Limitation of movements and spasm of muscle are ascertained in the same manner.

It must be remembered that in the early stages both are brought out only at the extreme range of movements.

All movements must be carried out in definite order, first on the sound side, then on the affected side, and carefully compared.

Place the patient supine.

To test Flexion.—The one hand *must always* fix the pelvis and note carefully any movements or tilting produced.

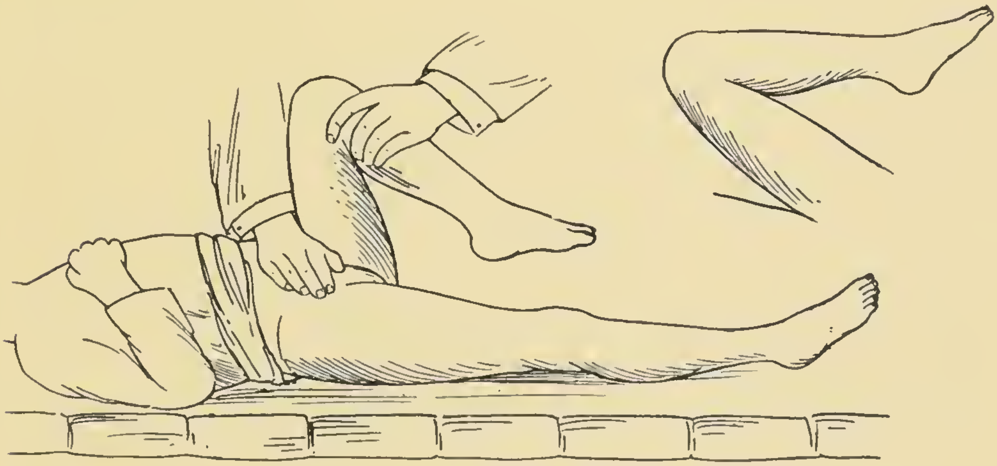

FIG. 67.—Shows the limitation of flexion at the hip (see text). Inset is a diagram showing the amount of flexion in a healthy subject; the thigh easily comes into contact with the abdomen.

Grasp the condyles of the femur (or the ankle) and flex the hip; on the sound side the thigh comes readily into contact with the abdomen, without resistance or pain. Marsh says flexion and *adduction* is the correct test.

On the affected side before the end of the movement two things will be observed :—

(*a*) Definite resistance to the flexion by muscular spasm.

(*b*) Tilting of the pelvis.

Extension.—Lay the patient prone on his face. Grasp the sound ankle and bend the knee to a right angle, now extend the femur to its full extent until the pelvis just begins to tilt, and note the position.

Do this on the affected side; definite resistance followed by tilting of the pelvis will be felt much earlier.

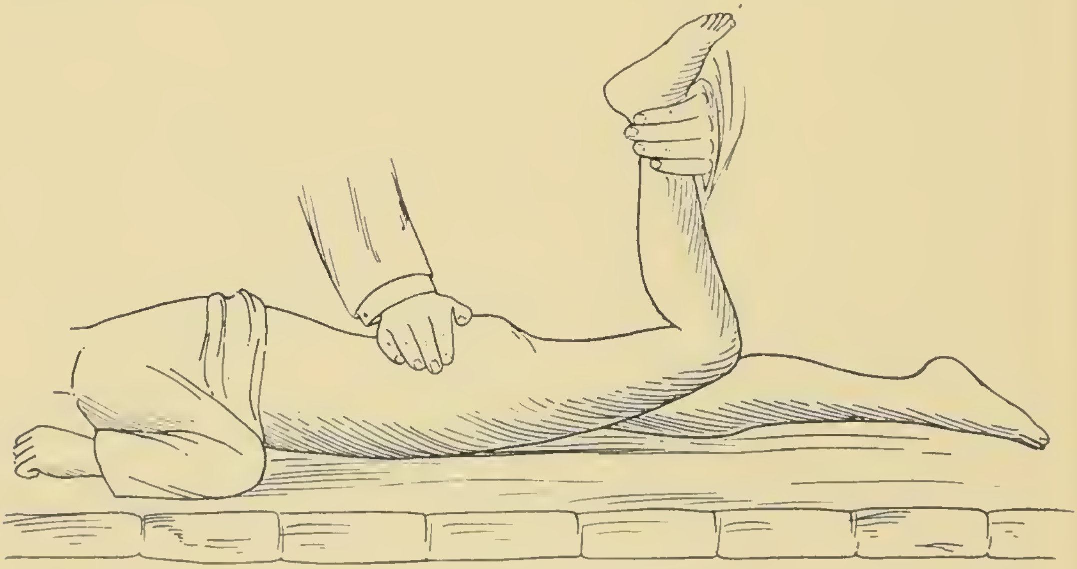

FIG. 68.—Testing for limitation of extension at the hip (see text).

Repeat both tests by fixing the pelvis and *asking* the patient to perform the movements actively. Practically no movement, *i.e.*, extension, is possible on the affected side.

Abduction and *Adduction.*—Grasp the pelvis with the thumb below the anterior-superior spine and the fingers on the dorsum ilii. Abduct the limbs by grasping the ankle and note the spasm and tilting of the pelvis on the two sides. Repeat abduction and adduction actively.

Circumduction or Rotation.—Flex the knee and hip both to a right angle by grasping the ankle, now rotate the femur inwards and outwards and circumduct, and compare the spasm and limitation on both sides.

The *tailor's position* generally betrays spasm and limitation of movement even in the earliest cases and is a good test for children, who enter into its performances voluntarily after a little patient effort.

The *atrophy* of the thigh should also be measured. Identical points measured from the adductor tubercle, or the upper border of the patella—*i.e.*, some fixed bony point—must be ascertained and the girth taken carefully and with equal tension at this level.

It is wise to measure two places, one about the apex of Scarpa's triangle, the other some 2 in. or so lower. The calf also should be measured for future reference. Many elaborate methods of measurement are in vogue, but appear to me to be unnecessary for general purposes.

A necessary precaution in taking measurement of shortening or lengthening, in order to have a fixed standard, *i.e.*, the actual length of a healthy limb as against the relative lengths of the two limbs symmetrically placed, is to place the *sound limb* parallel with the mid-line of the body. Place a tape from the episternal notch, over the umbilicus and pubic symphysis, and prolong this line beyond the feet; now place the sound limb parallel with this tape and make all length measurements with the limb in this position.

Measurements should be taken from the *umbilicus* to the malleoli, also from the anterior superior spines to the malleoli (see fig. 61).

The DIAGNOSIS has to be made between :—

(1) Coxa vara.
(2) Rheumatism and other forms of synovitis.
(3) Spinal caries and sacro-iliac disease.
(4) Congenital dislocation.
(5) Infantile paralysis.
(6) Pseudo-paralysis of rickets.

Treatment of Hip Disease { Local. General.

THE LOCAL TREATMENT.—Unfortunately it is impossible to apply congestion hyperæmia by means of a bandage to the hip (except by constriction of the waist, which has been and may be used with due precautions), and we are strictly limited to the use of the suction glasses. These are usually employed only when there are sinuses: but as the hyperæmia induced by the suction method extends to the depth of at least 2 in., and induces hyperæmia of bone also, I personally employ suction by glasses made to fit the varying contour of the hip.

The glasses are applied in three places :—

(1) Over the external aspect, involving the trochanter entirely.

(2) In front over the site of the head and neck, between the tensor vaginæ femoris and the femoral vessels.

(3) Posteriorly above and behind the trochanter, where the glass easily fits.

The three glasses may be applied simultaneously for the orthodox time, five minutes on and three minutes off, for six times, or they may be applied singly during the course of the twenty-four hours.

As the patient, or a sensible parent, very soon learns to apply the glasses, they are most useful adjuncts to treatment, and I have no hesitation in recommending their use in all cases.

With this addition the local treatment resolves itself into dealing with the joint infection as a whole, and with the symptoms as they arise.

In this country the almost universal treatment is to *fix the joint* by an apparatus, the form oftenest used being Thomas's single or double hip splint (fig. 69).

In AMERICA fixation is supplemented with slight *traction*, a modified form of Thomas's splint with a foot-piece, projecting well below the foot, is used; to this the extension plasters are fixed by webbing straps. Perineal bands for counter-extension are essential (fig. 70).

In certain parts of the Continent apparatus of a more complicated type which embodies the two principles of *partial* fixation with extension is used, and allows of early use of the limb.

It is estimated that treatment will extend over one to three years in uncomplicated cases, and longer in the complicated cases.

Personally I have derived so great benefit from the use of iodoform-glycerine injections, once the joint cavity is involved, that I always use it.

In the very earliest stages of localized disease in the neck of the bone, or near the base of the trochanter, everything appears so favourable for complete and early eradication of the disease that trephining and removal of the whole bony area is frequently resorted to, and immediate closure of the wound is carried out.

But the successful cases are few and far between;

recurrence is the rule, and, on the whole, far better results are obtained by prolonged palliative measures.

If the disease is still confined to the neck of the femur. I think that nothing equals absolute rest in bed for a short time in any form of hip tuberculosis; consequently the patient is put to bed, and if the flexion tends to persist an extension of 1 lb. to 4 lb. weight is applied until all spasm of muscles relaxes, and the limb is quite straight. This is supplemented with regular use of the suction glasses.

After about eight to twelve weeks rest in bed and suction hyperæmia I apply local counter-irritants about the trochanteric fossæ, beginning with the alcohol compress, and going on to flying blisters, the intention being to maintain a reflex chronic hyperæmia of the bones.

This is continued for about four weeks, the extension being used constantly.

After this sixteen to eighteen weeks treatment, the patient is fitted with a Thomas's KNEE splint, and, with a patten on the sound foot, he is permitted to get about on crutches. Extension is effected by strapping.

The splint is removed at night, and the suction glasses are regularly used.

In this way, with intermittent blistering and suction, the patient wears the knee splint for at least another six months.

Then an X-ray photograph is taken, and the condition compared with the original negative.

If this is satisfactory, the knee-splint may be abandoned, and the patten and crutches with the suction continued for another six months.

Or if progress is not satisfactory, the patient is put back to bed, and a more severe counter-irritation applied either by repeated severe blistering or by the use of the actual cautery, the burn so produced being kept active by an irritating ointment.

After a month or six weeks the patient is again permitted about, wearing the splint, and the suction glasses continued.

At the expiration of eighteen months an X-ray photograph is again taken, and if repair is well marked the splint is removed, the crutches used for another three months, and again an X-ray is taken.

At the end of this time the bone will generally be found apparently healed.

As recurrence of a tuberculous bone focus is very prone to occur, it is wise to maintain treatment some time after all the symptoms have quite disappeared and the X-ray shows a normal appearance.

No violent exercise should be permitted for at least three years.

The best places to apply the blisters or the cautery are around and about the trochanter; the blisters may be placed occasionally over the trochanter, but the cautery should *not* be used over it.

General.—As the nutrition and cure of the patient depends upon a healthy gastro-intestinal tract, the state of the naso-pharynx and the mouth is carefully seen to. If there are nasal troubles or adenoids, they *must* be removed; septic tonsils should be *enucleated*, and all stumps extracted, carious teeth stopped, the rest of the teeth scaled, and the gums carefully attended to by astringents. If there is gingivitis of a purulent nature, a Bier's elastic bandage should be worn on the neck, with soft pads placed over the internal jugulars (see p. 477) *as a palliative.*

The teeth and mouth should always be cleansed before and after *every meal.*

Under these circumstances the patient will usually digest his food well, and can be nourished by a nutritious diet.

As loss of blood may be minimized by the administration of calcii lactatis gr. xx. to xxx., according to age and size, the evening before the operation, adenoids and tonsils, &c., can be removed with less shock and general disturbance than formerly. In any case the septic intoxication is more harmful than the operation, ultimately.

I strongly *advocate a rich meat diet,* and if conditions permit I give patients ℥ss. to ℥ii. of raw meat juice daily, which I believe to be superior to tuberculin treatment.

The meat from which it is prepared should be recently slaughtered, and the juice kept in an ice-safe.

It may be given twice a day either in milk or by soaking bread in the juice.

I do not believe in an exclusively milk diet, and do not think the fattening process which follows a large milk dietary is a sound criterion, and it may be a very fallacious guide.

The bowel should be induced to act daily, and in the smaller patients this is brought about by a judicious use of fruits, confections, occasional doses of cascara, or a calomel powder. Daily action is highly important and a mixed dietary is beneficial in this respect.

Plenty of rest and sleep is also desirable, and the usual open-air treatment carried out.

Local Treatment (*continued*).

If the *epiphysis of the head* is affected the rest in bed and extension is more prolonged as a rule, and instead of simple fixation by means of a Thomas's HIP splint, an extension apparatus should be attached to it to maintain the relaxation of the muscles (see figs. 69 and 70) and prevent pressure absorption.

The various American modifications of Thomas's hip splint to provide a considerable degree of extension can readily be improvised by a little ingenuity.

A perineal band in some form or another is essential or a half ring, fitting tightly against the tuber ischii, can be attached to the upright, and serves the purpose of counter-extension admirably.

I do not agree with the authors who condemn movements, and I advocate active or passive movements wherever possible.

If the synovial membrane is affected or the bone lesion is infecting the joint, the patient is put to bed with a mild extension and I inject iodoform-glycerine into the joint cavity. The quantity used varies according to the conditions present, and may be ʒii. or ℥i.

It is wise to administer gas or other general anæsthetic. The point behind the trochanter is selected (see p. 463), the patient is brought near the edge of the couch and slightly tilted to the sound side. Every aseptic precaution is used. A small puncture with a tenotome is made through the skin, then a fine trocar and cannula is passed into the joint. If it is directed forwards and inwards it strikes the neck of the bone, and is gently passed a little further towards the head; then it is certain to be within the capsule. The syringe-nozzle, containing the iodoform-glycerine, fits the cannula, through which ʒii. or more are injected; if the resistance to its exit from the syringe then becomes marked, the syringe is removed, and if the quantity is really too great it readily returns through the cannula; on the contrary, more may be required.

I think it wise to *distend the joint* and keep it in this condition for a few minutes and then allow the excess of fluid to escape through the cannula.

The joint is moved about a little after the injection; when the cannula is removed firm pressure on the track is made with a gauze swab, then a dry sterile dressing with plenty of wool and a firm spica is applied.

A morphine injection relieves the pain which is necessarily produced.

In two or three days the pain of this proceeding ceases; reaction as shown by temperature, pulse, &c., is not marked.

The suction glasses are begun after the fourth day, the mild extension continued, and the general health and feeding seen to. Many authors consider extension is contra-indicated in these cases and a Thomas's fixation splint is more suitable.

If only a little synovial membrane is infected by tuberculosis, a considerable effusion may occur and the extension should be removed; the need for this is tested by gently removing the weight and finding out if the patient's comfort is enhanced thereby. As the effusion is absorbed extension may be reapplied. In no case is a weight greater than 4 lb. necessary, unless at first the spasm is marked and requires a greater weight, or if the patient is muscular; later the smaller weights are reverted to. Adults require up to 8 lbs.

When an examination of the joint is made, some two or three weeks later, the amount of tenderness, induration and tension must be carefully estimated, and the temperature chart observed; if all are improved, continue the mild extension and suction glasses.

If the local condition is worse it may be due to the amount of the reactionary effusion or to extension and exacerbation of the disease, and the question of aspirating the fluid may arise. This should not be done under a month's time unless there is a positive indication, as frequently the whole thing subsides and improvement follows about this time.

If pain is increasing and the tension does not decrease, it is wise to remove the fluid and re-inject a small quantity of iodoform-glycerine; the amount used depends upon the quantity of fluid removed; one-fourth of this would be a maximum quantity to use, but ʒii. to ℥ss. usually suffices; the bigger quantities tend to excite too great reaction and lead to suppuration.

The secondary injections, especially if not too large, are usually succeeded by much less reaction and effusion, and the joint should be left alone for some two or three months, careful examination being made from time to time. During this period extension in bed is most beneficial, but at the end of three months a Thomas's hip splint should be fitted on and the patient allowed to get about, first in an invalid's carriage and later on crutches, if conditions are satisfactory. Extension is maintained on the splint.

All cases in which iodoform-glycerine is used should be treated in bed, and if at a later stage further injections are necessary the patient must be put back to bed.

As abscess formation is rather predisposed to by iodoform injections, the absolute rest in bed is essential and the quantity used must not be excessive.

The *question of movements of the joint* is very important; while an extension is used the joint is constantly being moved to a slight degree, and this should be encouraged, and gentle passive movements also. When the Thomas's splint is worn properly bandaged (or belted) round the pelvis and in the region of the knee, movements are practically impossible, but if the pelvic band is removed and the bandage around the leg loosened when the patient is put to bed at night, slight movements are performed and passive movements may also be carried out to the extent permitted thereby.

When the patient can be put into a Thomas's splint it is wise to have an X-ray taken and the condition of the joint examined; the formation of fibrous tissue impregnated with iodoform may cast a well-marked shadow, but the size and shape of the outline and the bony condition are well seen.

If an intra-articular abscess forms it is evacuated by the aspirator or trocar and cannula just in the usual way, and a small quantity of iodoform-glycerine re-injected.

Two injections at an interval of a month, or slightly less, generally suffice for the earlier stages.

The ambulatory treatment, with the use of Bier's glasses, and movements carried out at night, is continued for twelve months without intermission.

The hardening and firmness of the healing granulations, the relief of tenderness and pain, the increasing ease of movements, all are good signs.

At the end of eighteen months, and in favourable cases earlier, the hip splint is removed at night and the remissions also increased by removing the splint whenever the patient lies down for a prolonged interval.

By this method about twenty months' treatment enables the patient to get about without the splint on, and in another three or six months he may be allowed out without the patten, so as to make some use of his healing hip.

At the end of two and a half to three years he will in all probability be soundly healed, if the suction glasses have been used all the time, with remissions of seven to fourteen days every six weeks or two months.

Cases are healed earlier than this, but as relapse is very frequent in hip tuberculosis it is wise to prolong the treatment.

The general treatment already indicated is, in my opinion, of the highest value.

The chronic ulcerative type is treated in the foregoing manner, but the extension *must* be maintained while the patient wears the Thomas's hip splint to prevent absorption and shortening.

This can be done with a little ingenuity, as stated on p. 315, quite sufficiently (without any form of expensive apparatus) on the ordinary Thomas's by passing a carefully padded perineal band from the chest hoop and upper extremity of the vertical iron and then applying traction on the leg, *while* the thigh, knee, and leg area are firmly bandaged to the splint. Only moderate extension is necessary, one must remember.

A proper plaster extension can be fixed to the thigh and knee if desired, and the ends fixed to the calf hoop by means of webbing or strong tapes with or without buckles.

A *Lovett's* extension splint can be made if necessary.

If the case is first presented with marked flexion, abduction, and eversion, extension applied to the thigh and knee with the weight acting *in the plane of the thigh must be carried out in bed.* When the limb has assumed the normal posture the Thomas's splint can be worn.

Thomas's Splint.—The *correct form of Thomas's splint* consists of a *straight* back-piece, *i.e.*, NOT following the curve of the lordosis, and the limb-piece is also *straight, i.e.*, without any curve; the only curve is that connecting the back and limb segments which fits the shape of the buttock.

Such a splint permits of, yet assists the disappearance of the lordosis and flexion, even if put on with an angle corresponding to or slightly less than the flexion, without preliminary rest in bed with extension.

The chief difficulty lies in the abduction, but by grasping the vertical with two pairs of strong pliers the iron may be torsioned to a certain degree to correspond with the abduction.

The flexion and abduction very soon diminish as a result of the rest, certainly within fourteen days, then disappear, and the splint can be straightened accordingly.

The *vertical iron* is 1 in. wide, $\frac{1}{4}$ in. thick, or $\frac{3}{4}$ in. wide and $\frac{3}{16}$ in. thick, according to the size of the patient. It is made of malleable iron, and is covered with a layer of boiler felt, over which an "inner sole leather" sheath is sewn.

It extends from the angle of the scapula to beyond the swell of the calf, and passes down just outside the sacro-iliac joint.

There are three hoops fixed at right angles to the vertical ; the highest and lowest are at its extremities ; the middle one grasps the thigh just below the fold of the nates.

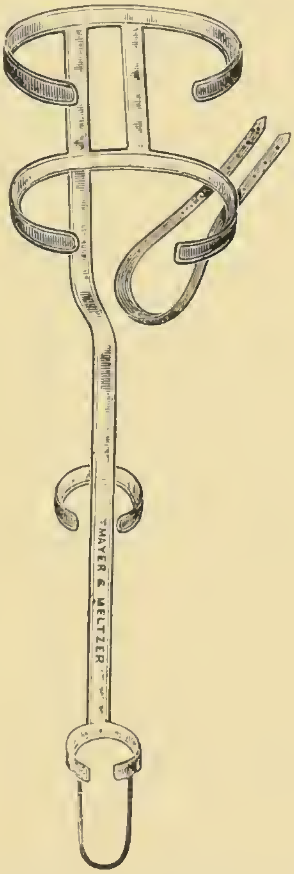

FIG. 69.—A single Thomas's Hip Splint, with foot and perinea extensions.

They are made of malleable iron, and are not complete hoops.

The *highest* hoop is incomplete by 4 in. or so, to enable the body to slip sideways through the gap.

The short limb of necessity is on the affected side.

The *middle hoop* embraces two-thirds of the thigh, and is fixed to the vertical with equal limbs.

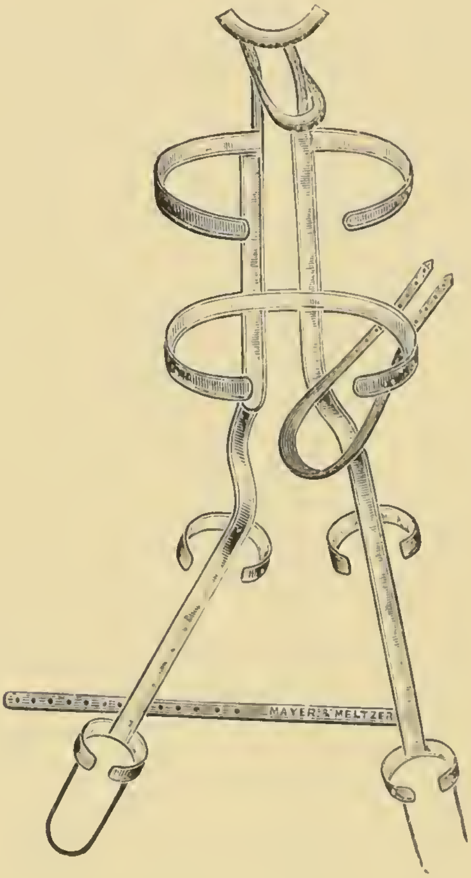

FIG. 70.—A composite diagram of a modified Thomas's splint suitable for (*a*) treatment of caries in all parts of the spine ; (*b*) for hip disease.
The splint as represented has (1) an occipital and chin support for head extension, which is adaptable ; (2) the usual thoracic thigh and calf hoops of Thomas's splint. *In addition*, there is (1) a pelvic hoop grasping the ilia, and to which is attached one or two perineal bands for counter-extension ; (2) to the calf hoops are welded iron extensions for the purpose of applying traction to the limbs ; (3) a crosspiece, which is adaptable, to secure the limbs in abduction and afford rigidity, &c. ; (4) the junction of back and limb irons may be made with a joint for ease in changing the amount of abduction.

The *lower hoop* embraces half the leg, and is fixed on the vertical with equal limbs. They are covered with felt and leather.

In order to prevent the splint slipping down two straps of webbing are attached to the chest hoop on either side of the vertical by oblique loops. These straps are crossed when the splint is worn to pass over the opposite shoulder, like a trouser brace, and fastened on a buckle attached to the front of the hoop.

If a perineal extension is required a fourth hoop is added just at and above the iliac crest (as in a Lovett's splint), but usually a firm, broad band or belt should be here fixed to grip the pelvis at the level of the antero-superior spines. A firm bandage is used instead when expense is an important matter.

The worst deformity, from the point of view of walking when the disease is cured, is that of adduction; and, if permanent ankylosis must occur finally, every effort should be made to convert this position into one of abduction. This is possible in all cases except when bony ankylosis has already occurred.

The difficulty of influencing either abduction or adduction is much less than that of overcoming eversion and inversion; the later forms of deformity may be most persistent, but if abduction is being aimed at then some amount of eversion is also necessary, to make the shortening as little apparent as possible.

If *peri-articular* abscess has occurred this is treated (*a*) by incision and the use of suction glasses. Neither packing, tubes, curetting, caustics, nor antiseptics are used;

(*b*) Or by aspiration or evacuation by trocar and cannula with the use of iodoform-glycerine subsequently.

The former is the better mode of treatment and is the only suitable one if the X-rays show a well-marked dense sequestrum in the joint or bone, which is rare.

Sinuses are treated by the suction glass, without any other manipulation, but if numerous and leading to considerable areas of carious bones, the sinuses are *all excised*, if possible, or very thoroughly curretted; then they are all stitched firmly with fishing-gut sutures, except one, and through this a quantity of iodoform-glycerine is injected till it oozes out at all the sutured sinuses; then the open sinus is closed by tying the sutures which have been *inserted* previous to injecting the emulsion.

If the *joint* is distended with serous fluid (hydrops) or with pus (empyema), the treatment by incision and the use of suction, or aspiration with or without iodoform-glycerine, is also carried out, followed by blistering and counter-irritation. In these cases extension and fixation on account of pain are rarely necessary, but as the patients have very insecure joints it is wise to treat them by rest in bed and fixation, at first, and then by crutch and patten.

In empyema, if there is reason to suspect grave destruction of the capsule and ligaments, rigid fixation is desirable for a considerable length of time, to enable the soft structures to contract and form a capsule capable of restraining the excessive movements of the femur.

If *pathological displacement exists* and grave disorganization of the joint is present, I prefer to use a Thomas's hip-splint with extension plaster, and permit the patient to get about on a patten and crutches.

But if any deformity is maintained solely by fibrous ankylosis an extremely good position will usually be attained by weight extension in bed, at first in the line of the femur but gradually correcting by altering the position and height of the pulley.

Pathological displacement is never really reduced, and it is best to let the patient get about in a hip or *knee*-splint with extension for six to nine months, while the socket is consolidating and the ligaments strengthening.

Operative interference is best deferred to a later period if the deformity is due to bony ankylosis, and even then no operation on the *joint* should be undertaken. A sub-trochanteric osteotomy, with sliding of the fragments and wiring or impacting in good position, is the ideal treatment.

But to effect this preliminary tenotomy, myotomy, and fasciotomy may be necessary.

Probably leaving the displacement alone and wearing a high boot on the affected foot is the better treatment on the whole, certainly for some years.

If the *general health is precarious* from grave tuberculosis elsewhere or amyloid disease, or the pain in bones is excessive, and there are multiple sinuses with extensive burrowing and destruction of muscles, &c.; or if the septic osteo-myelitis, usually present by this time, is extending or involving other bones, especially the pelvis, and the latter can only be effectively treated after amputation, under such grave conditions Furneaux-Jordan's amputation is indicated.

It is almost never carried out in children, but is necessitated in the recrudescences of middle age.

Operative interference other than incisions (arthrotomy) for drainage or removal of sequestra is not followed by the results one would anticipate, and the tendency at the present time is to avoid operation if possible, and treat by the measures previously indicated.

Excisions have been, on the whole, unsatisfactory for the ordinary type of case, but before performing an amputation thorough excision may yet prove successful in providing drainage and permitting of a recuperation which may be followed by recovery from the disease.

Extension.—In the case of small children, who *will* wriggle about, it is necessary not only to keep the body in a straight line, but flat on the back, else abduction, or in the late stages the adduction, will still persist in spite of the extension.

To effect this, two plans are followed : First a towel broad enough to cover the chest and upper abdomen from axilla to the pubis is stretched across the child and the ends rolled round two sand-bags of considerable weight, which are placed in contact with and on either side of the trunk.

Modifications of the towel plan are easily invented, a sort of jacket with holes at the four corners being the favourite mode; the holes are situated at the back, and through them two webbing straps are strung and fastened on either side to the bed frame. Sand-bags are essential to prevent wriggling.

In the case of refractory children a forehead bandage similarly applied is a most effectual but irksome measure to attain quietude, and may be used at first, then taken away if the patients become reasonable, and may be held as a threat if they are naughty.

Otherwise a long Liston's splint is attached to the *sound* side.

Counter-extension is secured in two ways: either by raising the foot of the bed on blocks and allowing the weight of the body to act as counter-extension ; or in the case of small infants a perineal band, passing under the *healthy* perineum, is fixed to the head of the cot.

The actual extension is applied to the thigh or thigh and leg. If there is *considerable* flexion the extension is applied at first only to the thigh :—

The affected hip is flexed until the lordosis disappears ; the position the thigh now assumes is maintained by means of pillows or a double inclined plane of wood, and the weight is applied so as to act in the line of the thigh.

After a few days the pillows or inclined plane are slightly lowered, *to a degree short of producing return of the lordosis*, and the pulley over which plays the cord carrying the weight is lowered to the corresponding level ; in this way gradual disappearance of the flexion is brought about, even if due to fibrous ankylosis.

If there is also abduction the weight extension first acts in the abducted flexed position, and so gradual correction attained.

If the flexion and abduction is moderate in degree the thigh and leg are both used for extension ; the whole limb is elevated, with the leg extended, until lordosis disappears and the extension applied in the line of the elevated limb.

The most difficult deformity to correct is the eversion ; this is best corrected by firmly bandaging or strapping a piece of board at the back of the knee at right angles to the leg, to which, as a lever, an *internal* rotating force of elastic webbing may be applied, or the outer end may be supported at a higher level than the inner end. The reverse tactics serve to correct inversion when present.

The strapping for the weight consists of strong diachylon on holland. Two strips are cut long enough to extend from the great trochanter to 8 in. beyond the foot. The upper end is one-third the circumference of the thigh, and it gradually tapers to about one-third this width.

The lower ends are fastened to the *under* surface of an oblong piece of wood. This "spread" is not necessary when only the thigh is used for extension, but is absolutely necessary when the leg is utilized, as it is when the limb is straight. The spread is 1 in. wider than the width of the malleoli.

To firmly fix the strapping to the spread (and prevent it adhering to any part of the foot or malleoli accidentally), an additional piece of strapping is fastened to the *upper* surface of the spread, and which extends on either side for 4 or 5 in. along the inner surface of the extension strips.

TUBERCULOSIS OF THE KNEE.

This affects patients from childhood to young adult life, and to a slight degree is more frequent in males.

In *children* it is said to begin with equal frequency in the synovial membrane and in the epiphyses or the diaphysial line (as an osteitis).

But in *young adults* it is far more frequent as a primary bone disease which extends to the joint. Its commonest site in order of frequency is :—

(1) Internal condyle of the femur.

(2) Internal condyle of the tibia.

(3) The external condyles.

(4) Very rarely in the patella and fibula.

The predisposing and exciting causes are those common to tuberculosis in general.

The signs and symptoms already given (see page 248) apply to the knee.

The *clinical* stages may be divided into those :—

(1) In which the bone or synovial membrane is locally diseased.

(2) When the joint is universally involved and there is erosion and destruction of cartilage.

(3) When there is deformity and abscess formation.

When the bone is locally involved there is aching, boring, dull pain, with sense of weight, tenderness on pressure. Some local or general increase in thickness

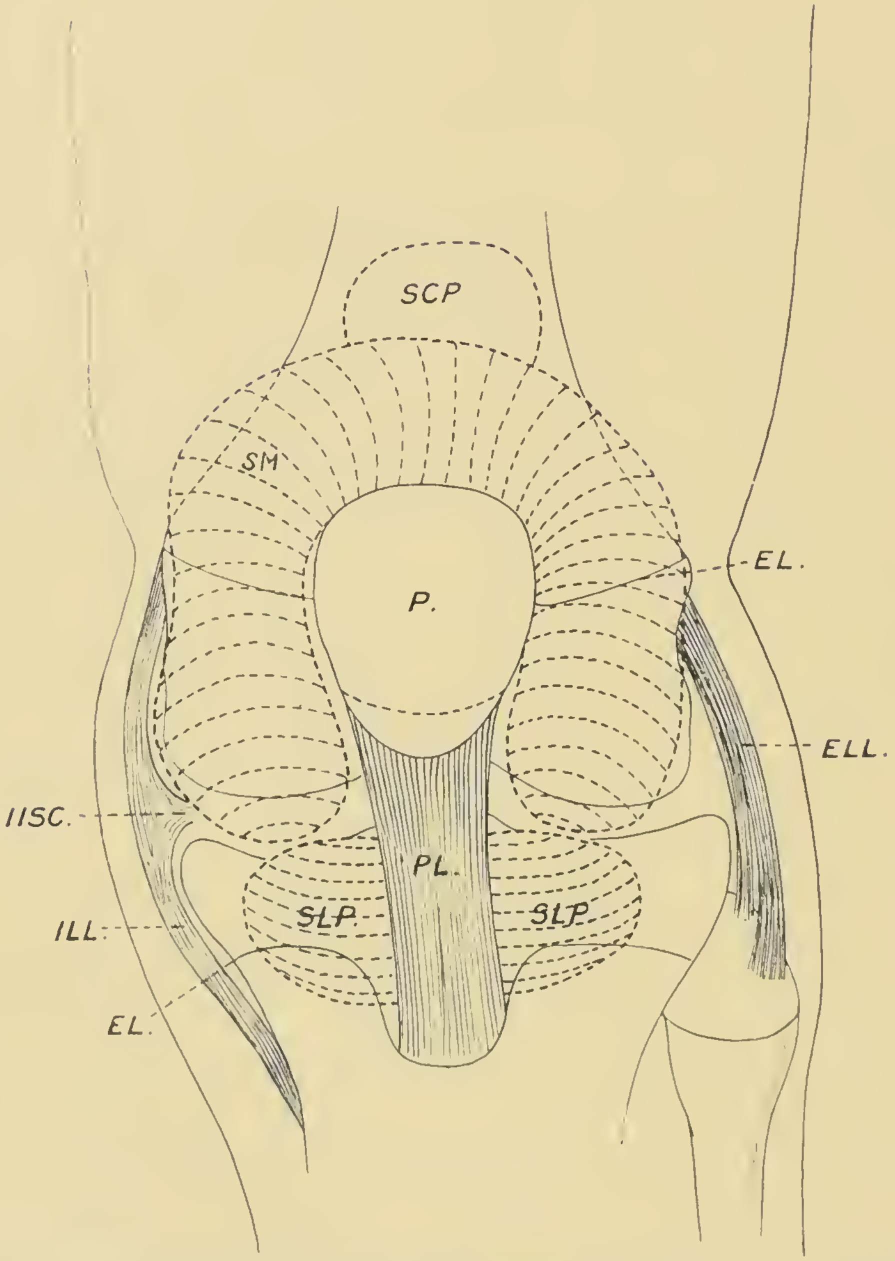

FIG. 71.—The important structures about the knee. *P*, the patella, embraced by *SM*, the synovial membrane; *SCP*, the subcrureus pouch, opening from the synovial membrane; *SLP*, the bursal tissue and pads of fat under; *PL*, the ligt. patellæ; *ELL*, ext. lat. ligt.; *ILL*, int. lat. ligt., and *IISC*, the attachment for int. s. f. cart.; *EL*, the epiphysial line. *Note* the patella is too high, its lower extremity is normally at the level of the cleft of the knee and is the best landmark for it. The shaded area, *SLP*, is often the earliest part to swell in osteo-arthritis and may be the only swelling throughout, also this area becomes prominent whenever the synovial membrane is distended with fluid, *but it does not form part of the cavity of the knee.*

of the bone or soft structures, probably œdema, can be made out. There is a slight limp, and jarring produces pain or discomfort. Stiffness in the joint is frequently complained of. Muscular atrophy beginning.

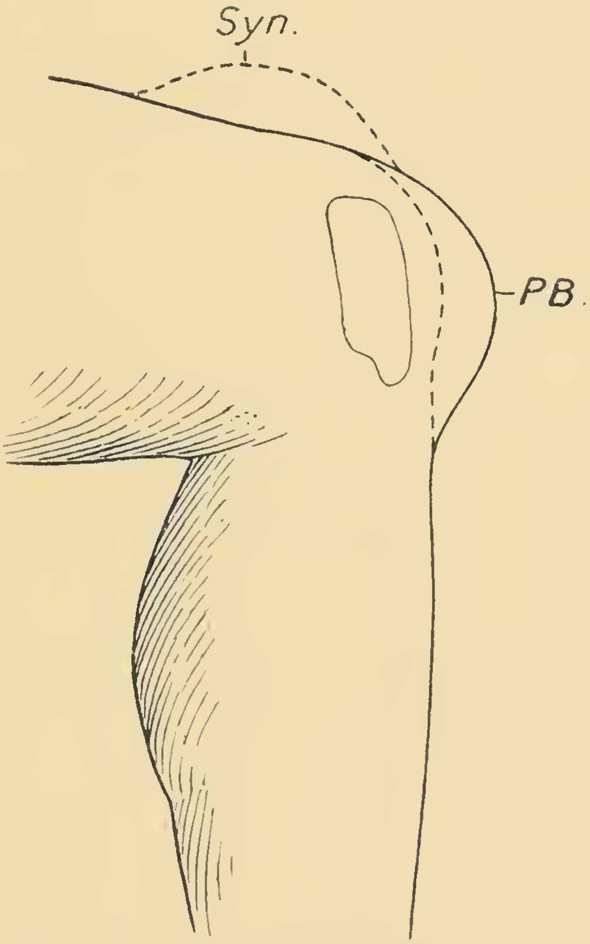

FIG. 72.—The swelling due to bursitis lies in front of the patella *PB*, that due to synovitis is above (*Syn*) and at the sides of the patella.

When the synovial membrane is affected locally, there is less pain and general discomfort. The thickening of the membrane is apparent at the edge of the tibia or in the supra-patellar region, where it rolls under the fingers. A slight effusion may be present. The condition resembles a subacute synovitis.

In these stages there is at most limitation of extention, chiefly at the *extreme stages*; there may be slight flexion, the patient endeavouring to walk on the toes to save the jar of walking. GENERALLY the patient gets into the condition of malaise, and there may be slight elevation of temperature.

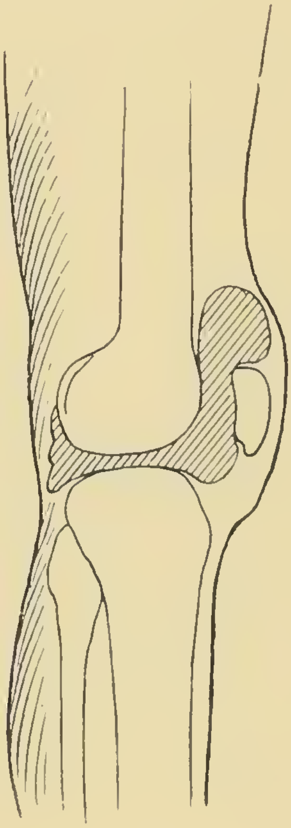

FIG. 73.—Represents the distended synovial membrane, pushing forward the patella and bulging above it (see fig. 72).

When the whole joint is involved all the symptoms become marked. The *pain* is more or less constant and severe. Definite *swelling* occurs, obscuring and filling up the hollows at the side of the patella.

When the whole joint is filled with granulation tissue, unlike pure synovial effusion, this swelling does not distend, accentuate, and retain the definite outline of the membrane for any length of time; it becomes tumid, "expressionless," and indefinite, gradually shading off into the adjacent area, and finally forming a globular or spindle-shaped swelling.

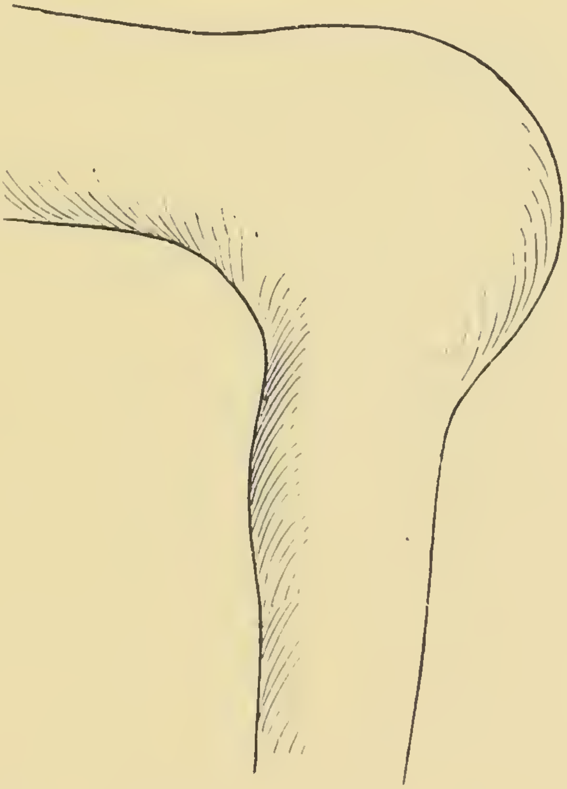

FIG. 74.—The typical outline of a tubercular knee in the late stages, *when untreated.* The limbs are much wasted, the hamstrings are contracted, there is dorsal dislocation of the tibia and the whole joint is disorganized.

The skin is not red, but the veins may stand out more prominently. There is considerable tenderness over certain points.

The POSTURE is now becoming that of definite flexion, and may be associated with external rotation, *i.e.*, eversion of the foot. These are the first changes, but not infrequently real genu valgum is present, although only to a moderate degree, enlargement of the inner side of the joint is common. At a later period *backward displacement* takes place.

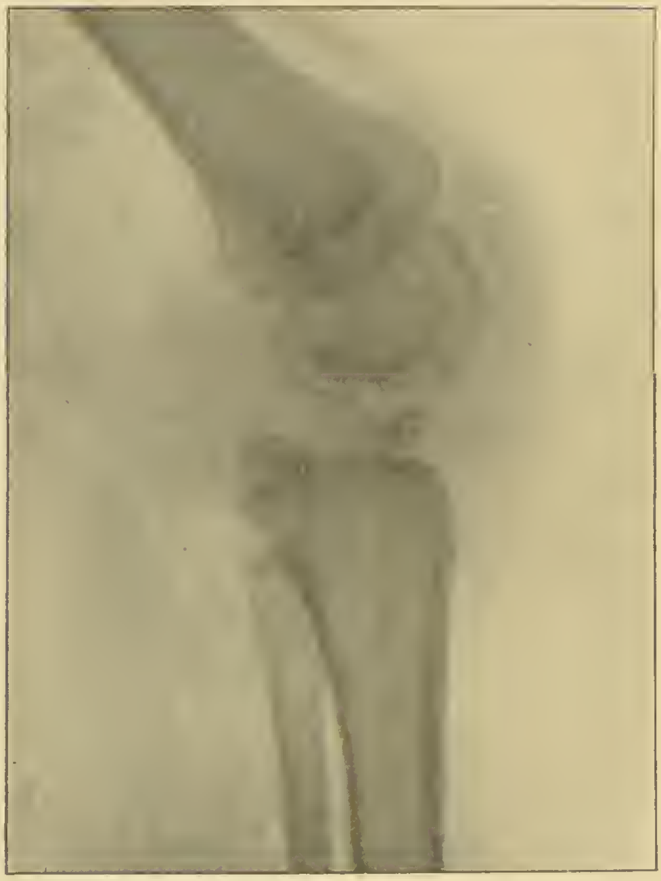

FIG. 75.—Represents such a condition as is figured above, but not so advanced. The joint is full of granulation tissue, the femur, and to a lesser extent the tibia, is gravely affected.

When the joint is palpated some increase in the heat is always apparent at this stage.

There may be *real fluctuation* if free fluid is present, or a pseudo-fluctuation if much granulation tissue exists (see p. 36).

The thickened synovial membrane can be demonstrated, with bogginess and œdema at certain spots where the process is more advanced and breaking down. The whole swelling is boggy and doughy, *i.e.*, non-elastic generally.

Movements are now definitely restricted and may be entirely resisted.

The *wasting*, especially of the thigh muscles, can be seen and measured, and the spasm on attempted movement is pronounced. The thin, wasted, flabby thigh accentuates the swollen spindle or globular-shaped joint swelling.

Soon the *typical* symptoms of erosion of cartilage—starting pains at night, increased wasting and spasm, and general deterioration of the health—set in, while backward displacement will be increasing.

Abscess formation is indicated by an increase in the general disturbance, *local* evidence of heat, redness, bulging, increased œdema and softening, &c.

If the capsule "gives" the shape and character of the swelling may change and a sense of relief is felt, followed, however, by a recrudescence of symptoms and obvious subcutaneous abscess formation.

Abscesses burst in a most irregular manner. If the osteitic abscesses have *not* invaded the joint, the femoral varieties tend to discharge on the inner or outer side of the knee at the intermuscular septum above the epiphysial line. The tibial abscess, likewise, opens chiefly on the inner side (at the lower part of the tuberosity, but no definite position can be assigned to the site of the disease by the location of the sinus.

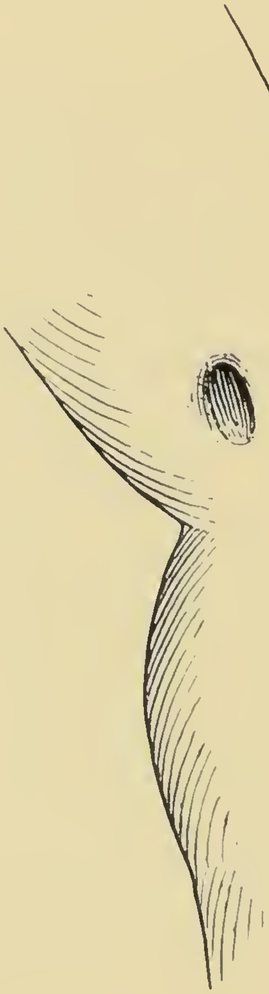

FIG. 76.—The position of an old femoral abscess which had burst in the intermuscular septum, leaving a puckered scar.

There may be either abnormal, *i.e.*, lateral, movement in the joint or ankylosis.)

Rough grating crepitations may be felt if the joint is abnormally mobile.

If the tibia is subluxated, definite shortening may be present; otherwise the hyperæmia of the epiphysial line tends to increased growth, so that at this time there is generally slight lengthening of the tibia.

Finally, sinuses form, and the condition becomes more or less variable, and the joint usually quite disorganized; recovery may take place or the patient die of septic poisoning or tuberculous meningitis, &c.

Treatment while the disease is confined to bone:—

Bier's method of passive congestion by a bandage.

The *intensive* method already described is carried out, see p. 262.

The knee, in a large number of cases, reacts but slightly to the bandage alone, in which case improvement will not take place, and in certain instances the method has therefore been abandoned; but if either *counter-irritation* or the intermittent application of the wool elastic pressure is combined with the Bier's bandage (p. 263) reaction will be secured and improvement follow.

Otherwise the moderate compression method (see p. 262) should be tried after a period of counter-irritation, or alternately with the wool compression used three to six hours during the day.

The *Associated Treatment.*—I think it is much the wiser plan to put these patients to bed until any spasm which may be present is allayed, and until the Bier's is in good working order.

Then the advisability of fitting a Thomas's knee-splint or a poroplastic splint, which are easily taken off, must be considered, so as to permit the patient to get about on crutches with a patten on the sound boot.

With careless or reckless patients this is the only way to prevent jars and strains to the joint, but in early cases if patients are reliable the wool-elastic compress can be worn instead of the splint during the times they are about. In either case the splint should be removed at night. In the morning the Bier's bandage is used for one hour, after which the patient remains in bed with the limb elevated for two or three hours. Then the wool-elastic compress or the splint is applied, and the patient may get about. So in practice the patient remains in bed in the morning, is about some hours in the afternoon, and then either returns to bed or rests on a couch till an early bedtime.

While the patient is in bed the limb is freely but carefully moved by active or passive efforts.

Occasional counter-irritation is of real service, and during this time the patient should be confined to bed.

After six to twelve months the splint can be discontinued, but the crutches used for another three months; after which, if clinical evidence and the X-rays show that the bone is healthy, the limb at the end of twelve to eighteen months may be gradually used. The Bier's bandage, however, should be persisted in for another six months at least.

The advisability of injecting iodoform-glycerine into the diseased bone should be considered if improvement is delayed, and I think it a highly successful adjunct, especially as it invariably increases the reaction to Bier's method of congestion.

If the patient is anæsthetized (a local regional anæsthesia will do) and the injection performed while the bone is rendered visible by X-rays, the diseased area can with certainty be infiltrated with the iodoform-glycerine.

General Treatment.—The specific attention to the gastro-intestinal tract mentioned on p. 268 must be carefully attended to.

If the Joint is involved:—

First, when only the synovial membrane is affected.

The same treatment, but more rigid fixation is necesary: a Thomas's knee-splint, or a poroplastic with a stay of iron along the back is used.

There are usually no starting pains, so extension is not *essential*, but as there is definite spasm of muscles (and starting pains may occur) an extension apparatus *should be employed at first.*

The traction must always be made *in the line of the tibia*, so that if flexion exists the femur is slightly elevated on a pillow to bring the tibia horizontal, so that the extension may act without pain, which it certainly produces if the traction is at a wrong angle; gradually the flexion is decreased by lowering the femur and pulley until finally the thigh and leg are in a straight line.

Extension by means of a weight of only 2 to 4 lb. will never do any damage; it may need increasing at first, but finally the small weights suffice to overcome the spasm.

Treatment in bed for about one month effectually straightens the limb and relaxes all spasm, and with Bier's methods the patient may then be fitted with a Thomas's or a poroplastic splint, and gradually allowed to get about on crutches, wearing a patten on the sound side.

The advantages of the ambulatory method more than counterbalance any supposed disadvantages.

As the two splints mentioned are both easily removed or loosened they are very suitable for use with Bier's bandage.

If the granulations are felt to be hardening, and the boggy feeling disappears, while the general swelling decreases, the treatment is successful.

Should it not be so, and the condition remains *stationary*, parenchymatous injections of iodoform-glycerine may be used, or the joint cavity moderately distended with the emulsion and the result watched, the patient being rigidly confined to bed. If softening by caseation is proceeding either generally or locally, the treatment is still continued until definite fluctuation is felt, when two methods of dealing with the abscess may be followed :—

(1) Aspiration with or without the use of iodoform-glycerine (p. 444).

(2) Or incision followed by gentle expulsion of the loose caseous material, followed by the daily use of the suction glasses (see p. 492).

If aspiration and iodoform-glycerine is used the Bier's bandage should be discontinued three or four days, and absolute rest in bed persisted in.

Too early incision is much better than allowing a large collection of pus to form.

If an extension apparatus is in use it *may* be wise to remove it after injections of iodoform-glycerine, for twenty-four or thirty-six hours, and then gradually reapply it.

Tentative trials with the weight on and off will guide one best in this respect.

IF THERE IS EXFOLIATION OF CARTILAGE or exposure of bone, Thomas's splint is the best splint to use, as extension by strapping can be maintained while the patient soon gets about on crutches.

Personally I think these cases always react well to iodoform-glycerine and pressure.

The fixation at first is more prolonged and absolute in this form of the affection than in the synovial variety, but after about three months extension-fixation in bed with two injections of iodoform-glycerine, the extension may be relaxed, and the limb *lightly* fixed in the splint while the patient remains in bed a few days longer, at the end of which time the splint may be gently removed (or the bandages only removed), and the patient encouraged to make slight active movements ; the splint or bandages are then reapplied.

It must be remembered that a Bier's bandage must not be used while the limb above the knee is bandaged to the splint ; so, as the fixation bandages consist always of one below the knee and the other above, the latter is removed during the time the Bier's is applied.

If, when the extension is removed, no starting pains or spasm reappear it need not be reapplied, and daily movements may be attempted *when the Bier's bandage is on.*

Treatment is continuous for nine to twelve months, then an X-ray is taken, and if the bone conditions are greatly improved, and all activity of the tuberculous process has ceased as judged clinically, the splint may be discontinued ; otherwise the treatment is continued as before for another three or six months, after which the patient may discontinue the patten and endeavour to use the limb, still aided for some time by a crutch or stick.

If there are abscesses they are treated as already stated. Efficient and early treatment greatly reduces abscess formation; probably less than one-fourth have abscess.

A *dense* sequestrum in an unopened abscess will *demand* an incision and removal, the wound being treated by immediate suture or by suction glasses till it heals.

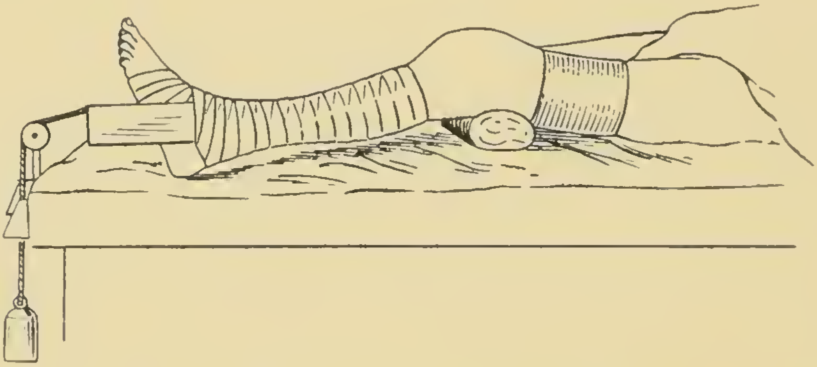

FIG. 77.—The gradual reduction of deformity by weight extension. The thigh is pulled backwards by elastic traction (the pad should be placed slightly lower).

A soft sequestrum will have broken down (see p. 247) and can be removed by trocar and cannula in the fluid forming the abscess, or an incision may be made and the sequestrum removed, after which the wound may be closed immediately or treated by suction till it heals and for some time after.

Deformity is treated on its merits.

Flexion occurs at two separate periods :—

(1) As an early protective process.

(2) As an insidious late fibro-cicatricial distortion.

Too little attention is directed to the fact that if the patella is fixed to the femur, backward displacement of the tibia *must* follow, and adhesion of the patella is a very early process which should be specially guarded against by passively moving it from side to side, or actively prevented by flexion and extension.

Extension in bed, the strapping applied to the leg as high as the tuberosities of the tibia, and a weight of 2 to 8 lb. first used, is usually successful in bringing the tibia into a straight line, unless there is bony union. Recurrence of the posterior displacement *can only* be prevented by wearing a splint for a prolonged period, in some cases for three to six years.

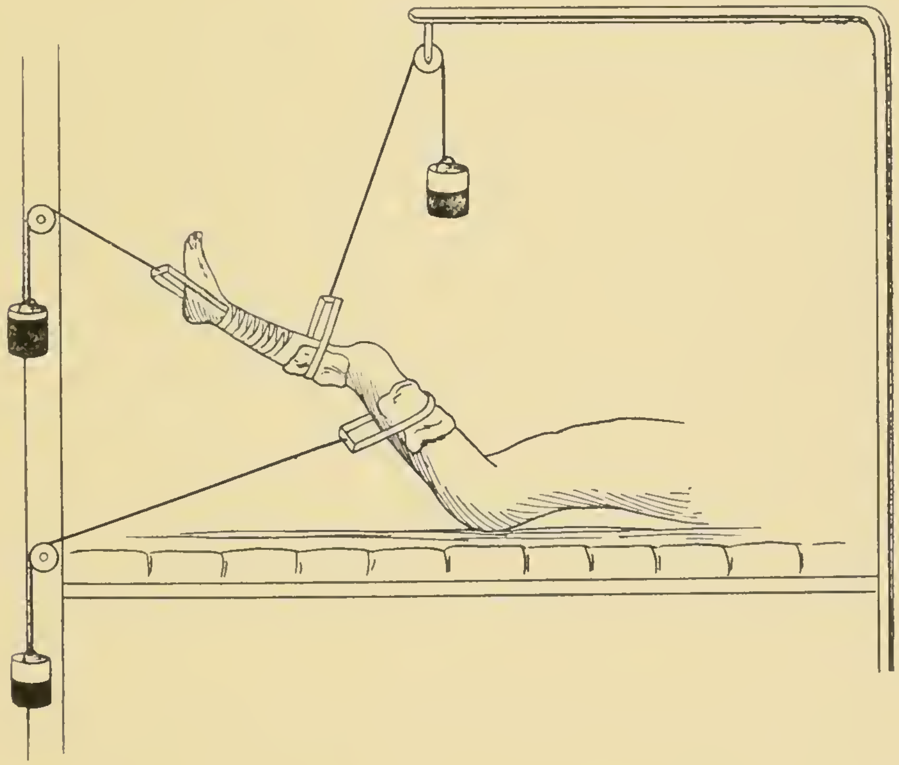

FIG. 78.—A more powerful method of reducing dorsal displacement of the tibia.

While the extension is acting it is wise to lay the *leg* on a pillow while the *thigh* is unsupported for as long periods as the patient will tolerate. Or an elastic loop may be passed round the thigh and its extremities fixed beneath to the mattress or bedding to exercise backward traction.

In grave degrees of deformity, especially with external-rotation of the tibia great force may be necessary to bring the tibia into extension.

This may be brought about by mechanical apparatus or operation.

The mechanical measures are:—

(1) That already mentioned — namely, prolonged extension by weight and pulley, the patient being confined to bed ; this is probably the best means.

(2) By Thomas's splint with extension straps. Pads are placed on the front of the thigh and back of the calf, over which a firm roller bandage is used, thus exercising direct pressure on the displaced bones. This method permits of ambulatory treatment.

(3) By Bier's orthopædic suction glasses—a most scientific method, but one which entails an expensive apparatus. During the intervals of treatment the limb is fixed in a suitable splint or extension applied.

(4) Or by applying plaster-of-Paris bandages, exercising corrective pressure from ankle to groin and changing them every week, each week permitting a better position to be assumed.

(5) Various expensive apparatus with rack and pinions, or ratchets, built on the plan of a Mackintyre's splint, with the extending bar stretching from thigh to leg-piece ; this is lengthened gradually, so straightening the limb.

Operative measures for correcting deformity :—

(1) Forcible reduction with or without fasciotomy, tenotomy, &c.

(2) Osteotomy of femur or tibia.

(3) Excision of the bones forming the joint.

THE OPERATIVE TREATMENT OF KNEE TUBERCULOSIS :—

(1) *Erasion or arthrectomy.*

(2) *Excision.*

(3) *Amputation.*

All forms of operative measures are being performed less frequently every year.

From the point of view of functional result the conservative measures yield at least 50 per cent. of movable joints, while after erasion this is reduced to about 10 to 15 per cent.

As the after-treatment of the erasion demands a prolonged period, there is little or nothing in its favour, but a great deal against it. Personally I do not think erasion justified, except that form by which localized tuberculosis of the synovial membrane forming pendulous masses may be removed.

Excision is a sounder operative measure and should always be carried out if bony ankylosis in a bad position is the probable outcome in any individual case ; but even after excision and pegging the wearing of a retentive splint is necessary in most cases for several years or longer.

In adults, in whom alone the operation should be done, it shortens the period of illness and is much preferable to any form of fibrous ankylosis. If the patella is ankylosed by bone to the femur, excision should always be carried out.

The principle which guides one in dealing with joints in the lower limb is to at least secure *stability* ; in the case of the upper limb *movement* is the great desideratum.

TUBERCULOSIS OF THE ANKLE-JOINT,

Including the ASTRAGALUS.

The ankle is diseased with comparative frequency in childhood, but far less often than the hip or knee. In young adult life and adolescence, however, it is affected *primarily* more frequently than either hip or knee. It is far more frequently of bony origin, the astragalus being the commonest site, although the lower end of the tibia, or fibula, or the malleoli may be first affected. *Primary synovial* infection does occur, but with far less frequency.

The *prognosis* is good, but the tendency to abscess formation is great ; according to various authorities over 80 per cent.

The good functional results of ankle cases in children, even after suppuration and but moderate care in treatment, supplies one of the best natural arguments in favour of the ambulatory treatment, aiming at a movable joint, in tuberculous joint cases in general. We have been too long dominated by the plaster-of-Paris absolute fixation, &c., school of treatment.

The SYMPTOMS *of the disease* are those of tuberculosis of joints in general, the *onset in the main* being insidious, although occasionally an acute flare-up may be the first evidence of the disease.

Discomfort or sensitiveness aggravated by any severe

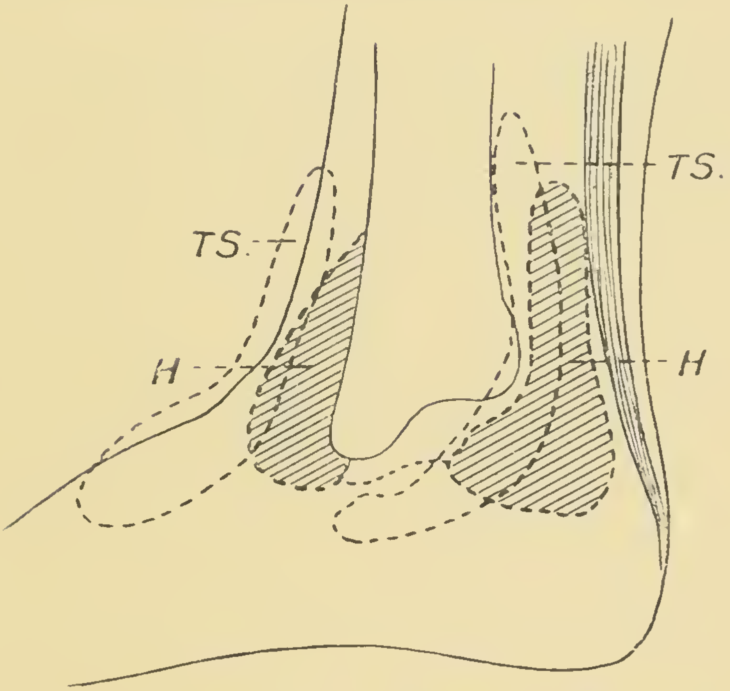

FIG. 79.—*From the inner side.* *TS*, Teno-synovial sheath swellings; *H*, The distension due to *joint* inflammations.

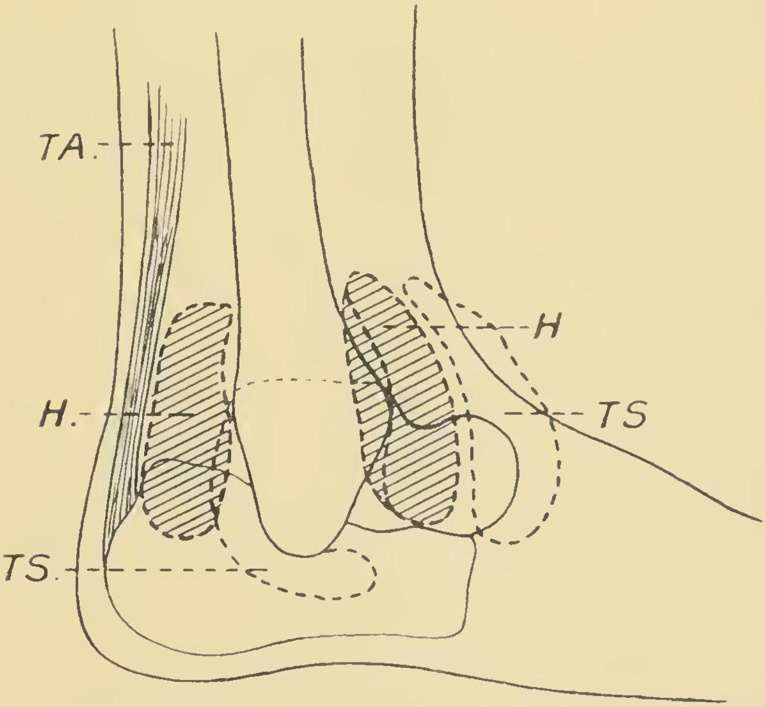

FIG. 80.—*From the outer side.* *TA*, Tendo-Achillis; other letters as above.

jars or twists, or aching and slight stiffness, may precede the obvious involvement of the joint cavity.

Pain is variable; there is generally some degree of pain, and this is made worse by walking. Then a *limp* develops fairly early and a definite *posture* is assumed; the lameness increases from any cause which aggravates the pain.

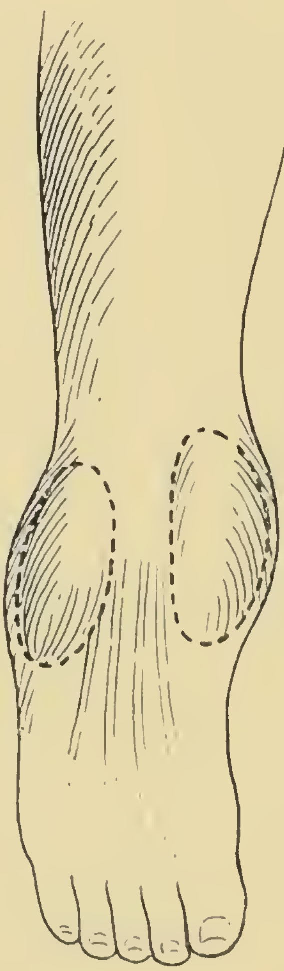

FIG. 81.—The shape and situation of joint swellings, *i.e.*, on either side of the extensor tendons.

The POSTURE assumed in the earlier stages is that of plantar flexion—*i.e.*, equinus; this is due to *spasm of* *the calf muscles* and must be corrected, else shortening of these muscles occurs.

As the disease progresses inversion and adduction takes place; so a position resembling talipes equinovarus is assumed (unless the foot is being used, when eversion may be present). This position may become permanent if not corrected. In the early stages the *limitation of movement—i.e.*, flexion and extension—in moderate ranges is not marked, so the equinus can be corrected by gentle pressure.

Eversion and *inversion* are not restricted at first, as they are not ankle-joint movements but take place between the astragalus and calcaneum, and to a lesser extent in the tarsal articulations. Later these movements become restricted by the spasm and shortening of the muscles, just as they are in paralytic cases.

If the malleoli are the seat of rarefying osteitis they generally enlarge by periosteal deposition of bone, and the enlargement is quite obvious.

Swelling—which, if marked, is due to breaking down, *i.e.*, abscess formation—is first found over the front, but as the extensor tendons lie on the front of the joint, the swelling becomes obvious between the *extensor tendons and the malleoli;* later, between the *tendo Achillis and the malleoli*, filling the hollows in front and behind the malleoli; so that increased width of the ankle is generally present, and is an easily observed condition. Before the granulation tissue breaks down there is pseudo-fluctuation, *i.e.*, it cannot usually be felt from front to back, but only from side to side of the extensor tendons, and the swelling is pulpy or doughy. Fluid may be present in the tendon sheaths and give a sense of fluctuation.

Abscess is known by the usual signs—softening, local swelling, often redness, heat, œdema and the enlargement of the veins in the skin. They generally point

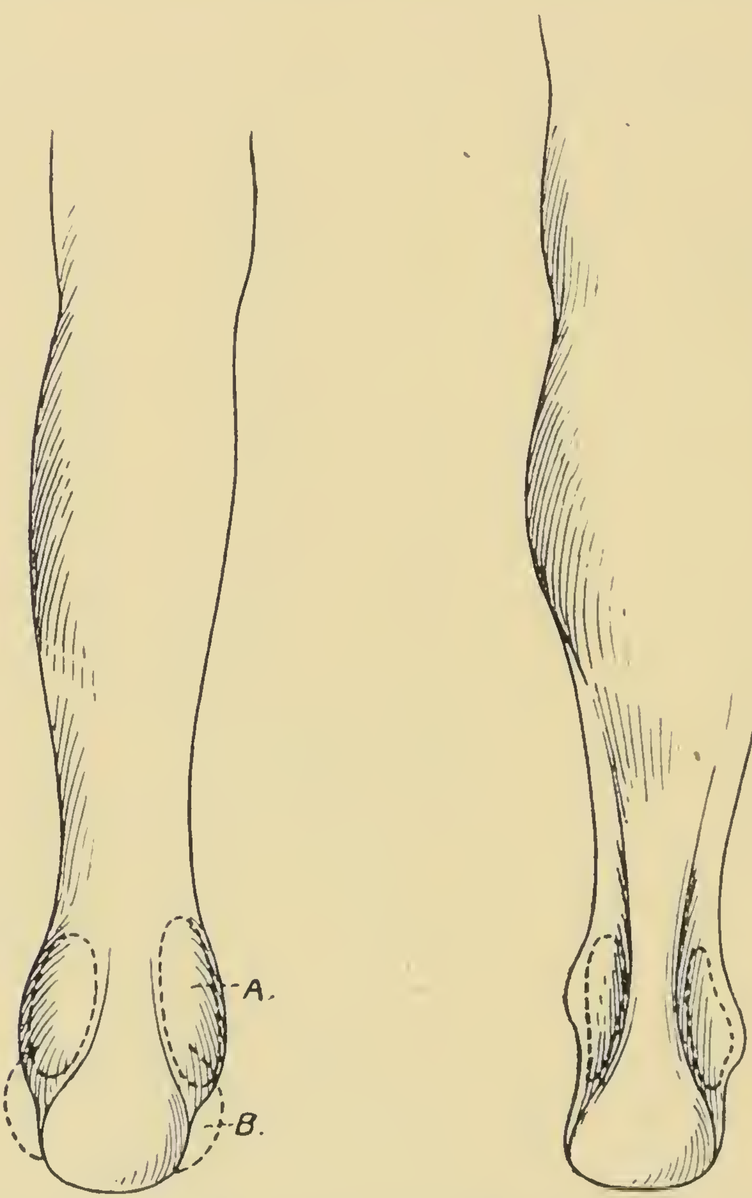

FIG. 82.—On the right the normal hollows between the malleoli and tendo Achillis are visible. In the left limb they are filled up by the synovial distension *A*. *B* represents the slightly lower position of the swelling due to astragalo-calcaneal tuberculosis.

in front of or behind the malleoli, generally above the level of the tip.

There is *marked spasm* of the calf muscles and *atrophy* of the whole of the leg muscles. If *nocturnal starting pains* occur they are generally very severe.

Lateral displacement indicates grave destruction of the bones and ligaments, especially malleolar caries.

If the *astragalus alone* is involved (see p. 360) the swelling is at a lower level than the ankle-joint and may cause considerable bulging on the instep, or at the sides in front of the malleoli, but there is no swelling BEHIND the malleoli. It is very rarely that the joint is UNinvolved.

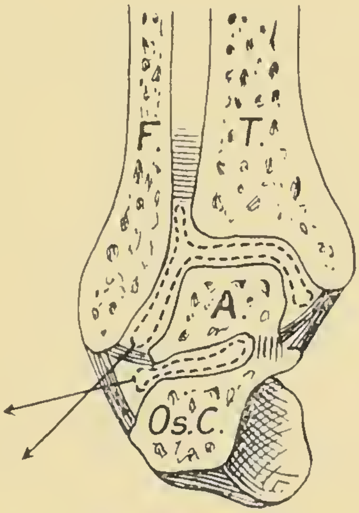

FIG. 83.—*Section of ankle-joint.* Astragalo-calcaneal tuberculosis shows as a swelling below the level of the malleolus, especially on the OUTER side. Ankle-joint swelling, while tending to the same position, is resisted by the ligaments and tendons, and is *equal* on the inner side.

The general condition varies, but when sinuses are present with septic infection, perhaps affecting the whole tarsus, a very grave condition may occur.

As some degree of shortening occurs, though generally not marked, this affection is often followed by scoliotic changes, because the inequalities of the limbs are overlooked or uncompensated.

Treatment.—No joint reacts more favourably to Bier's passive congestion than the ankle.

As extension by weights is hardly possible to apply, if starting pains occur, they may be very severe and need narcotics; usually, however, the posture assumed protects the joint considerably.

In the early stages absolute rest in bed with the limb elevated on a pillow is essential, and I think the careful application of a thick wool-elastic compress is the best means of fixing the joint and of preventing startings. An anterior or posterior rectangular poroplastic or an orthopædic splint will effect moderate extension; the foot-piece is first bandaged, and while it is pushed downwards the leg-piece, which extends to the tuberosity of the tibia, is then carefully bandaged, so that mild extension and fixation is effected.

This may be used alternately with the compression, the ankle area being carefully padded with grey wool (non-absorbent). Should the starting pains persist the splint should immobilize the knee also, which should be considerably flexed; for this purpose the posterior broad iron splint with a foot-piece (Arnold's) used for fractured tibia and fibula slung on a cradle acts most efficiently.

After a month in bed it is wise to allow older patients to get about on crutches, with a patten on the sound foot. Marsh gives pride of place to a rectangular leather splint.

The poroplastic rectangular splint, or a box-splint made of plaster-of-Paris, and extending from and including the tuberosities of the tibia to 2 in. *beyond* the sole, or a Thomas's knee-splint with a foot-piece to prevent equinus may be used to fix the joint and maintain relaxation of the muscles and prevent deformity. The Thomas's knee-splint should be used more often than it is in hip and foot tuberculosis, when this is confined to the bones. The Bier's bandage is applied in the morning, followed by rest and elevation (see p. 342).

If the condition goes on to abscess formation this is best treated by incision and the use of suction glasses. But if the condition tends to lag and becomes stationary injections of iodoform-glycerine are made (see p. 444); these may be used earlier if there is bone erosion.

Sequestra are not infrequent, and may entail incision for their removal, unless they are small and a sinus exists, when they are often extruded by the granulation tissue, or they soften and liquefy and then come away as pus.

The duration of treatment is determined by consideration of the clinical signs, and examination by the X-rays. Ambulatory treatment on crutches and patten, with a retentive apparatus to prevent deformity, gives excellent results with the use of passive congestion.

If Bier's method is not used, then erasion, with or without excision of the astragalus, at an early date is the best treatment, and is carried out through an external incision outlining the fibula and external malleolus, or an anterior transverse incision.

If *deformity* is already present this is corrected by the use of splints or plaster-of-Paris. These are altered every seven or ten days, each time correcting a certain degree of the deformity.

Mechanical apparatus can be fitted which work with a key and screw, so that the deformity is overcome by constant alteration of the angle. A general anæsthetic *with forcible replacement in the case of any tuberculous joint is a very dangerous procedure, and is best avoided until a year or two after subsidence of all active symptoms.* During this time a splint should be used to correct the posture, the final correction, if such is still necessary, being carried out forcibly and the position maintained by plaster-of-Paris, and prevented reverting to the bad position by an orthopædic boot (if it still tends to relapse). If there is bony ankylosis with equinus deformity excision of the astragalus is far the best treatment, and always provides a movable ankle, but with shortening.

Shortening is the rule and must be compensated for by a thick cork sole.

Operations, either erasion or excision, may be done, but not unless there is some special reason for operating, as the results are generally associated with greater shortening and a general tendency to recurring deformity. If the malleoli are removed very grave interference with the stability of the joint necessarily follows. Kocker's modification with excision of the astragalus gives the best uniform result, but there is much shortening.

Even after a successful arthrectomy with removal of the astragalus, the free use of the foot is not permitted for six or eight months.

TUBERCULOSIS OF THE TARSUS.

The larger the tarsal bone the greater the frequency with which it is involved in a tuberculous process. Thus the os calcis,
astragalus,
cuboid,
scaphoid,
cuneiforms,
is the order of frequency, followed by the metatarsals, especially the base of the first, and, a long way after, the phalanges of the toes.

In the case of the os calcis the process may be localized for a considerable time, and sequestrum formation is the rule, but in the case of the other bones general involvement of the foot synovial membrane occurs.

When the os calcis is involved there is tenderness and pain, increased on pressure or jarring. There is definite thickening of the bone and soft structures, especially about the level of the astragalo-calcaneal articulation, if this is involved.

Flexion and extension, as well as inversion and eversion, are unaffected until the astragalo-calcaneal articulation is involved, when inversion and eversion become restricted or impossible on account of the pain set up and the associated spasm of muscles. Plantar flexion is instinctively assumed, leading to some degree of equinus.

When the periosteum and subcutaneous structures are invaded local signs of abscess formation occur ; on the inner side the tendon sheaths are frequently involved.

Treatment.—Owing to the localized nature of the disease, incision and evisceration of the diseased bone is therefore frequently performed ; the cavity is allowed to fill with blood-clot or filled with the iodoform-paraffin or bismuth mixture, and the wound closed. If healing by first intention takes place, and after ten or fourteen days Bier's bandage is applied daily to the thigh, I have seen excellent results follow. But such also take place without operative interference.

When the *astragalus* is involved and the affection has not spread to the ankle-joint, or to the astragalo-calcaneal joint, the disease is very difficult to diagnose, and the indefinite pain or discomfort present is frequently considered to be rheumatism, or a sprain is diagnosed, as there is at some time or other a history of trauma or sprain, which usually, however, really would not be noticed were the disease not present. An X-ray examination will reveal the nature of the disease.

Treatment.—At this stage excision of the whole bone or evisceration is advocated, but I cannot agree that it is justified as a *primary* method of treatment. Bier's method should be the first treatment and usually renders operation unnecessary.

When the ankle-joint (see. p. 353) is involved the typical swelling, &c., appears, or, in the rarer cases, when the disease extends outside the joint capsule swelling *under* the extensor tendons on the front of the foot, midway between the malleoli, appears; this increases the height of the instep when viewed from the side.

When the astragalo-calcaneal articulation is involved the restriction of inversion and eversion is apparent, and a swelling simulating disease of the os calcis develops in front of the malleoli.

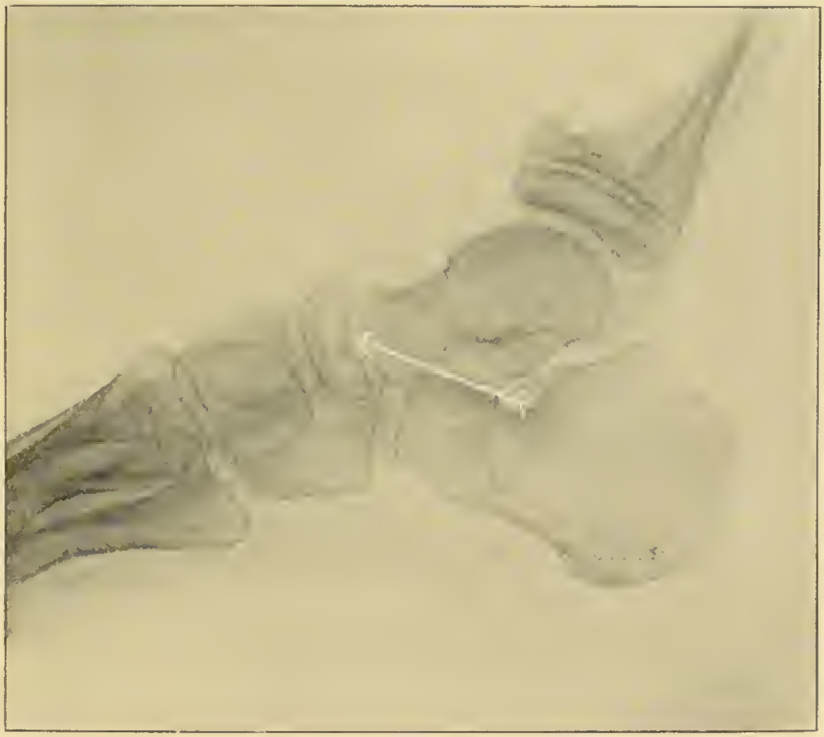

FIG. 84.—Caries of the scaphoid; the articular surface is irregularly eroded.

In the case of the other bones the local pain and tenderness, difficulty in walking, &c., in the absence of any other infective process in the body, especially gonorrhœa, with the appearance of a swelling of an indolent nature, leads to a diagnosis of tuberculosis; it soon spreads to other bones and joints and tends to become universal, although primary involvement of the internal cuneiform may long remain localized; the degree of spread depends upon the anatomical arrangement of the joints.

Where the disease is extensive the outline of the bones and the shape and character of the foot is entirely destroyed; abscesses burrow in all directions, and may be of considerable size in the sole of the foot, where they tend to gravitate, before they discharge; sinuses usually appear on the dorsum and the sides, more rarely in the sole. The plantar fascia is so dense and resistant that pointing is difficult here; if, however, it does occur, drainage is generally imperfect, puckering and distortion is apt to occur, and healing may be difficult to bring about from inversion of the skin.

In the case of children and adolescents who complain of protracted indefinite pains in the feet, which resists salicylate treatment and is not due to deformities, an X-ray examination will very frequently reveal a tuberculous focus.

Treatment.

To Bier's methods tarsal tuberculosis reacts very favourably.

Treatment in bed for two or three months is at first desirable, this being the best way to secure the necessary rest.

The use of a large wool-elastic compression bandage will often suffice to retain the foot at rest and in good position, otherwise an anterior or posterior poroplastic splint (according to the site of the disease) serves this purpose admirably.

Plaster-of-Paris in the form of a Croft's hinged splint or Marsh's leather splint may also be used.

(If Bier's bandage is used splints MUST be removable.)

As there is a great tendency to generalize, the early use of iodoform-glycerine injections into the area affected primarily should be considered, but as a rule it is better to wait to observe the result of the Bier's bandage in effectually localizing the disease, a merit in itself which justifies the method; should the condition spread however, then an injection should be given.

A suction-glass for the whole foot is probably the most effective means of using passive congestion.

The involvement of teno-synovial sheaths is not infrequent in the ordinary expectant treatment, but is largely prevented by the Bier's bandage.

If the disease is localized, a suction-glass may be used over the area now and again for two or three days, intermitting the use of the bandage on the thigh.

All swellings should be *incised early*, the caseous matter gently expressed, and the suction treatment carried out.

If sequestra exist, and are of the dense variety, they will rapidly be loosened when the bandage or glass is used, and can then be removed through an incision or by enlarging sinuses.

One of the difficulties of treatment is to retain the foot in a good position while the ambulatory treatment is carried out. There is no difficulty while the patient is in bed, as the Arnold's back splint, with rectangular foot-piece slung on a cradle, is most efficacious. When the patient gets about either a poroplastic splint, with or without an iron stiffening, or a Croft's plaster-of-Paris or the leather rectangular splint, is generally used.

If there is little or no deformity, a large wool-elastic compression bandage serves instead of a splint.

Movements of the toes are encouraged from the first, and the foot joints, especially those concerned in inversion and eversion, are maintained in a mobile condition if possible. Adhesion in the tarsus of any degree of firmness cannot usually be broken down by movements under an anæsthetic, as sufficient range and power cannot be exercised on the particular part, except by a wrench; hence they remain as painful adhesions for a long time, *i.e.*, till sufficiently stretched by the constant use of the foot.

The absolute immobilization of joints by plaster-of-Paris as advised so generally should never be carried out. Every splint used in joint cases should be an easily removable one.

To PREVENT the equinus and foot drop very little resistance is required, so that a poroplastic splint, which is light, easily made and applied, is quite effective. If marked deformity already exists, plaster-of-Paris or some kind of orthopædic shoe is necessary to correct it and prevent recurrence.

OPERATION.

Surgeons advocate early operation in tuberculosis of the foot, especially when the disease is confined to the bones, as they argue: "Remove the primary focus and you cure the disease." Unfortunately, the synovial membrane is frequently implicated by the time the surgeon sees the case, and eradication is then very difficult as it must be QUITE complete to be effective. The whole os calcis is very little missed, a pad $\frac{1}{2}$ in. thick worn in the boot under the position of the heel appears to recompense for its loss. The astragalus may be removed, and a movable joint always be attained, but there is considerable shortening.

Any of the other tarsal bones may be removed without apparent discomfort or loss of function. Personally I believe the need for operation is in inverse ratio to the skill and care with which passive congestion is used. Incisions or aspiration are not set operations dealing with the disease, but simply deal with the abscesses. Early incision should not be feared if a suction-glass is used, even if breaking down has not actually taken place.

TUBERCULOSIS OF THE SHOULDER.

The *shoulder* is more rarely involved in tuberculosis than any other limb joint.

It seldom develops before puberty, average age of onset 12, but is observed in infants; adults between the age of 18 and 30 are oftenest affected.

The *site of the disease* is the head or great tuberosity, then the neck of the scapula and glenoid cavity. The bursa under the deltoid muscle may infect the joint, or extension may occur from the acromion process or the bursæ under the spinatus and subscapular muscles, and *vice versa*.

The affection often assumes the form of a *caries sicca*, giving rise to bony ankylosis and much absorption of the head and neck of the humerus, and, to some degree, of the glenoid cavity. Abscess formation, however, is not uncommon.

THE SYMPTOMS AND SIGNS.

The *onset* is usually insidious, with local pain and stiffness, which at first is evanescent, but gradually increases and becomes more constant; soon it is aggravated by movements and there may be referred pains down the arm.

Early and considerable *tenderness* to pressure occurs. In the cases going on TO GRANULATION TISSUE FORMATION early *fulness* of the shoulder, with increase in its circumference, occurs; whilst the *attitude of the arm* at first is that of *abduction* with *internal rotation*, which, in the later stages, is changed into *adduction* and internal rotation, the arm being kept close to the side of the body; and there is great limitation of movements, although to some degree this may be hidden by the free movement which the scapula is capable of. The *spasm* of the shoulder muscles is well marked, and starting pains at night may be severe.

In the Dry Cases.—There is a transient fulness which is soon followed by loss of the round contour of the shoulder—flattening—due to atrophy of the deltoid, which becomes excessive, and as a result of which the *acromion* is rendered prominent. Later, on account of the actual absorption of bone, this is increased and a condition of elevation of the head of the humerus is associated with it, which leads to quasi-subcoracoid dislocation being diagnosed.

When Abscess forms.—There is always fulness of the shoulder region with evidence of distension or thickening of the deltoid; there may be local redness, œdema and bogginess. Definite fluctuation occurs and the axilla is often distended, while the pain and tenderness increases.

The general symptoms also indicate pus formation.

Pointing may take place at the anterior or posterior margin of the deltoid, generally near the border of the axillary fold, but it may be higher up in front.

Or the suppuration may involve the synovial membrane of the bicipital groove and burst on the antero-internal aspect of the arm. The pus may also come to the surface in the axilla.

Treatment.—It was in the case of the shoulder that uniformly good results were first obtained by a Bier's bandage, and which led to the shorter duration of its application.

In the case of this joint, as in all others, modified rest and fixation, and protection against excessive movements or trauma, must be provided.[1]

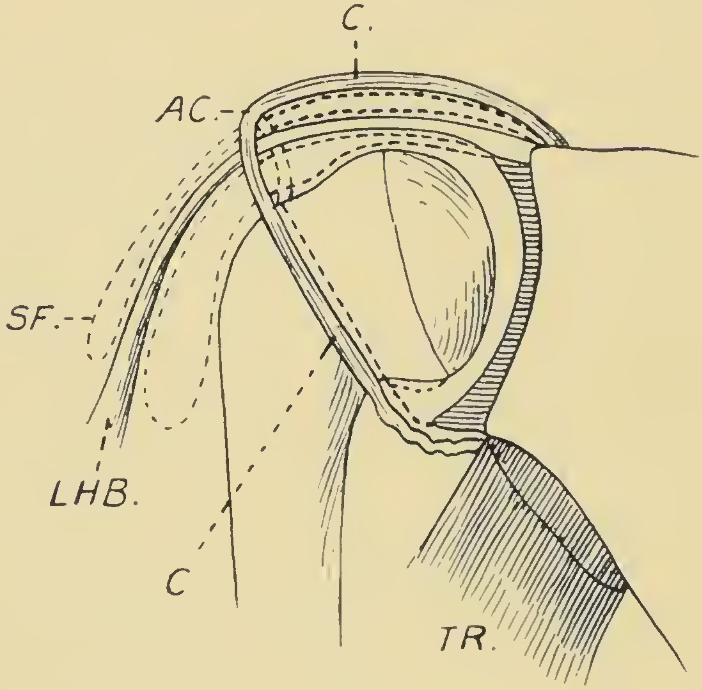

FIG. 85.—Diagrammatically shows the extension of the synovial membrane along the tendon of the long head of the biceps. *C*, Capsule; *AC*, the gap where the biceps emerges; *LHB*, long head of biceps; *SF*, synovial extension; *TR*, triceps.

While the disease is confined to the humerus the arm should be lightly bound to the side with the forearm flexed to less than a right angle and the wrist slung by a soft bandage passed round the neck, so as to allow the forearm to act as a mild extension.

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[1] As a general rule upper limb cases are too seldom treated by rest in bed, while lower limb cases are kept too long in bed.

The Bier's bandage is applied for one hour in the twenty-four (see diagram, p. 471).

Occasional blistering, alcohol compresses or the cautery may be applied.

Personally I believe the results of the marked reaction following injections of iodoform-glycerine into the joint cavity in cases where the disease is confined to bone enhances greatly the results of Bier's bandage, just as occasional blistering does. At most 2 to 4 drachms should be used.

The GENERAL health must be very carefully attended to, as phthisis often follows the development of tuberculosis of the shoulder, probably from its proximity to the pleural lymphatics.

When the condition is more advanced and the *joint is involved* the patient should be kept in bed at first and iodoform-glycerine should be used; $\frac{1}{2}$ oz. or more may be injected to distend the capsule moderately, and the arm moved about gently to promote its distribution, then the excess run off.

The patient is kept in bed with a mild extension of 2 to 4 lb. applied to the upper arm, which is placed in the position of abduction at an angle of 45 degrees, or the arm *may* be raised to a right angle with the body and supported on pillows with or without extension.

The extension is applied as for the lower limb, counter-extension being provided by a broad towel passed round the chest and attached to the bed frame on the sound side.

If the reactionary effusion in the joint is marked it may need aspiration, otherwise after a month or less the desirability of another injection of about 2 drachms should be decided upon general principles.

About this time the patient will be benefited by ambulatory treatment. The arm is best abducted to 30 or 45 degrees and fixed by means of a wedge-shaped splint, the two sides of which meet at the axilla. It can be made in the shape of a triangle of poroplastic, leather, or of a light wood. The apex is towards the axilla, the right angle side against the chest and the hypotenuse supports the arm; the junction of base and hypotenuse is continued forwards as a trough to support the forearm.

A series of webbing straps fixes the apparatus to the chest wall, and a sling supports the forearm. There should be neither inversion nor eversion of the arm; to secure that this is so the forearm is not crossed over the chest, but projects *forwards* at nearly a right angle to the body.

Abscess formation is treated in the usual manner, by—

(*a*) Aspiration,
(*b*) Incision followed by suction, or
(*c*) Aspiration and iodoform-glycerine.

Movements must be encouraged while the Bier's bandage is worn.

In the *cases of caries sicca* I advocate the use of iodoform-glycerine early.

If ankylosis occurs the joint is best left alone for some twelve months after cessation of all symptoms, then plastic arthrectomy is performed, and if possible a useful joint obtained. This is always imperfect, the medium ranges of movement only being possible; not infrequently it is very disappointing, and the question of deciding upon excision may be most difficult, and, on the whole, if the scapular movements are sufficient to permit of all useful purposes, a stronger limb is obtained by leaving the ankylosis.

TUBERCULOSIS OF THE ELBOW-JOINT

is considerably more frequent in females than in males.

About 40 per cent. of the cases occur before the twentieth year, but it occurs at more advanced ages, as a primary affection, more frequently than is usual in the case of the other joints.

Modern authorities produce strong evidence that its primary seat is infinitely more frequently bony than synovial. When the latter is primary it is said to be almost invariably in the radio-ulnar portion of the articulation.

The olecranon, then some portion of the epiphysis of the humerus, is the commonest site, and a frequent history of traumatism is given.

Here there is a great tendency to break down into abscesses, which tend to burst on the posterior or external aspect—owing to the site of the disease—and the formation of a flail-joint.

The SYMPTOMS AND SIGNS are those enumerated on p. 248 as typical of tuberculosis.

The *atrophy* of the muscles sets in very early and is marked. The *spasm* of muscle is generally severe.

Swelling occurs early and appears behind on either side of the olecranon, or in front over the outer aspect above the head of the radius, or in front and below the condyles.

The *sinuses* are most frequently multiple, and there may be great undermining and burrowing. They early become septic and cause considerable general disturbance.

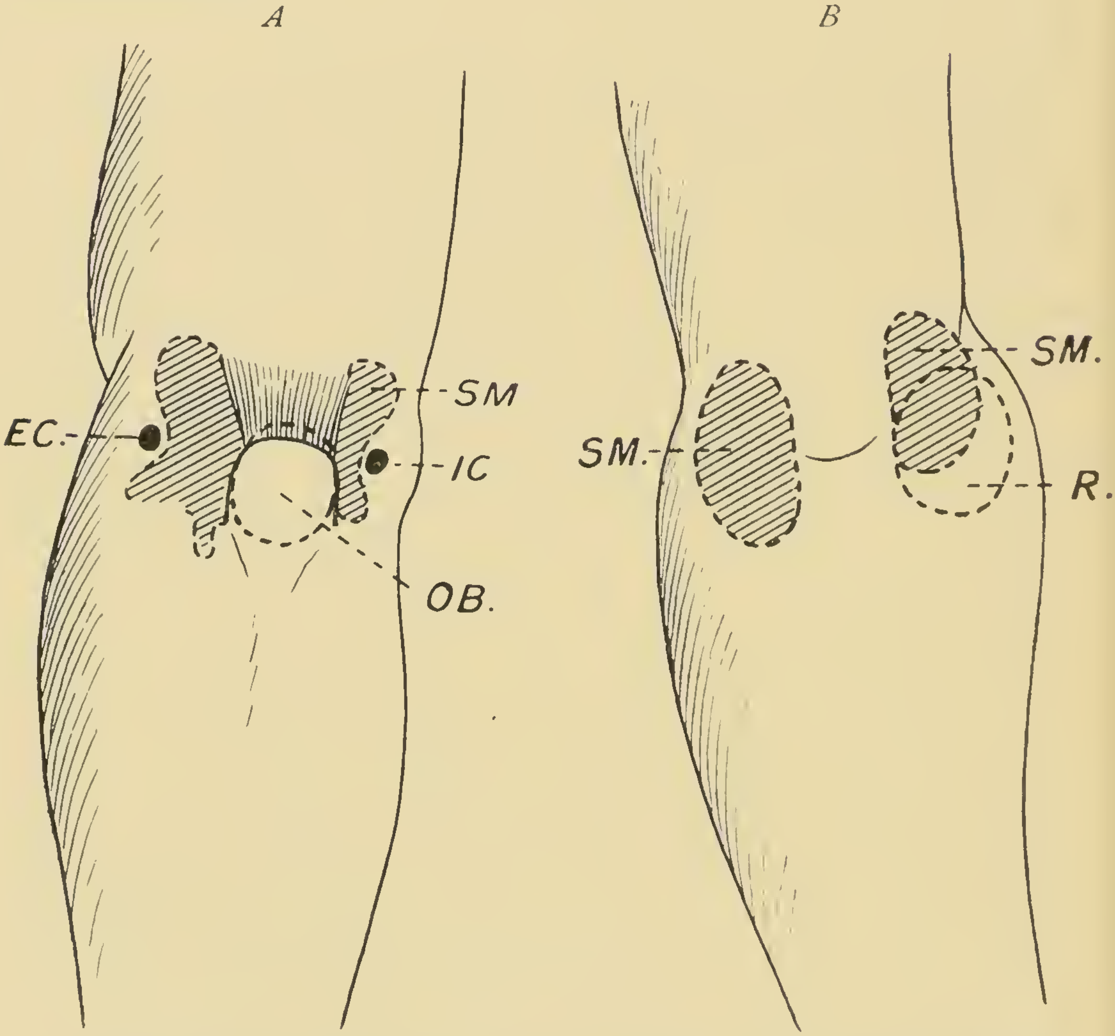

FIG. 86.—Shows the situations where swellings appear in tuberculosis. *A*, *the back of the elbow ;* *EC*, external condyle ; *IC*, internal condyle ; *OB*, olecranon covered by the O. bursa ; *SM*, synovial swellings on either side of the triceps. *B*, *the front of the elbow ;* *SM*, synovial swellings ; *R*, swelling due to disease of the radius.

The shape of the affected arm is very noticeable, the spindle-shaped swelling about the elbow in contrast with the marked thinning of the forearm and arm being very striking.

The undermined area looks bluish, and the superficial veins tend to become prominent.

Limitation of movement sets in early; extension is the most restricted, while flexion may be quite good.

Pronation and supination are restricted when the whole joint is involved or the radio-ulnar pouch affected.

The localized bony foci may often be made manifest about the elbow by the pain and tenderness on pressure over the affected part, by œdema and periosteal thickening, or by induration of the soft parts.

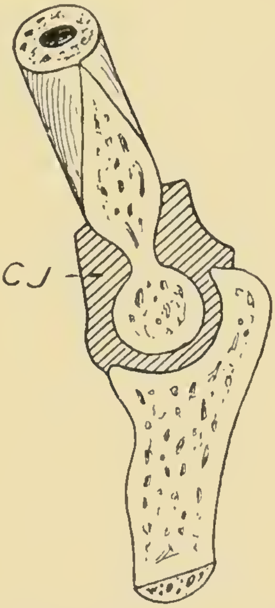

FIG. 87.—Shows the cavity of the joint in section.

Moderate effusion tends to obliterate the hollows adjacent to the prominent bony landmarks.

If ankylosis occurs the elbow is flexed to slightly less then a right angle, while the forearm is in mid-pronation. Fortunately this is in almost the most suitable position for use, *i.e.*, an angle of 90 to 110 degrees.

The olecranon foci often burst posteriorly without infecting the joint, but even in these cases extension is somewhat restricted, in some cases considerably so.

Treatment. — Authorities who do not use Bier's methods differ so widely in the prognosis they give of the affection in this joint when dealing with its treatment in children that they flatly contradict one another; some advocate conservative measures, the others early operation.

When it affects adults there is a greater unanimity in favour of operation, *i.e.*, resection.

The same difference of opinion as regards functional results is also noticeable.

Conservative measures with Bier's bandage and the use of iodoform-glycerine when abscesses form give better results in children than operation.

While the disease is confined to the bone, the forearm should be slung and the upper arm bandaged to the side, with or without a rectangular moulded splint.

Active movements are gently carried out, but great care is taken to avoid jars and strains. Counter-irritation is not advisable in these cases, as it is in most joint affections.

Personally I use the small suction glasses to supplement the Bier's bandage; they must be made to fit the contour of the patient's arm around the infected areas.

When *effusion is present*, aspiration and injection of iodoform-glycerine is used. As reaction is well marked, the quantity of iodoform-glycerine withdrawn after distending the joint is greater than usual, and if the reactionary effusion after this precaution is still great, it is wise to aspirate it early and replace with a small quantity of the iodoform-glycerine.

Fixation of the joint may be carried out very successfully by a Thomas's knee-splint modified to apply to the shoulder. The padded ring fits the shoulder comfortably, and is strapped by webbing and buckles round the thorax. The splint is bent at right angles at the elbow. The anterior iron runs just dorsal to the radial margin, while the posterior iron is anterior to the ulnar margin, so that the forearm rests on the leather brace as in a trough.

The arm and forearm are bandaged to the splint, while the elbow is left free.

The forearm and splint are then slung around the neck.

Otherwise poroplastic and leather form excellent splints. An anterior moulded splint is most comfortable.

Careful general treatment and nutritious diet, with the congestion bandage and modified rest, will generally result in a cure, in six to twelve months, *and a movable joint*. Plaster-of-Paris absolute fixation should never be used for this joint.

If fixation by ankylosis is inevitable, the elbow must be placed at an angle slightly more than 90 degrees, with the forearm midway between pronation and supination.

Abscess and sinuses are treated as usual. The wool compression treatment generally suits elbow cases, and should be used to supplement the Bier's bandage; it is best applied at night, and the Bier's adjusted soon after it is removed in the morning.

Operation.—In *adults* excision gives a movable joint in a large proportion of cases; often, however, the joint is rather weak, and may be flail. The retention of the lateral ligaments intact is a very important detail from this point of view.

It is stated that too early *extensive* movements after excision tends to produce a flail-joint, though more probably this is due to excessive removal of bone.

In *children* interference with growth generally follows, and, if possible, erasion and conservative removal of bony foci only should be done.

TUBERCULOSIS OF THE WRIST-JOINT.

Like the shoulder, this is invariably a disease of adult life associated with phthisis.

Its prognosis therefore depends to a greater extent than usual upon the associated lesion.

It may originate—

(*a*) In the lower end of the radius,

(*b*) Any of the carpal bones, or

(*c*) The bases of the metacarpals (especially it is said the base of the second). Fortunately when it involves the metacarpal bones it tends to extend into the shaft, in which case the joint escapes, otherwise the whole wrist joint rapidly becomes involved, as also may the adjacent extensor tendons.

Symptoms and Signs.

The disease begins in the typical *insidious* manner, generally in a patient of feeble vitality, or one suffering from chest symptoms. A laborious occupation, such as that of a blacksmith, predisposes to it.

In the early stages a localized boggy indefinite swelling, or œdema, with pain on movement and tenderness on pressure, will exist. But when the condition infects the whole joint a special deformity and posture makes the diagnosis easy.

Swelling invariably shows on the dorsum quite early; the extensor tendons are raised by an indefinite boggy swelling extending over the back of the hand, somewhat assuming the shape of a Colles' fracture.

There is some fulness of the front of the wrist, but the fulness of palm and lower forearm seen in compound palmar ganglion is absent; this is more localized, unless the flexor tendons are also involved.

The *deformity* produced when the disease is well developed is quite characteristic, the fingers are fully extended at the metacarpo-phalangeal articulations, while there is just a tendency to flexion at the distal interphalangeal joints.

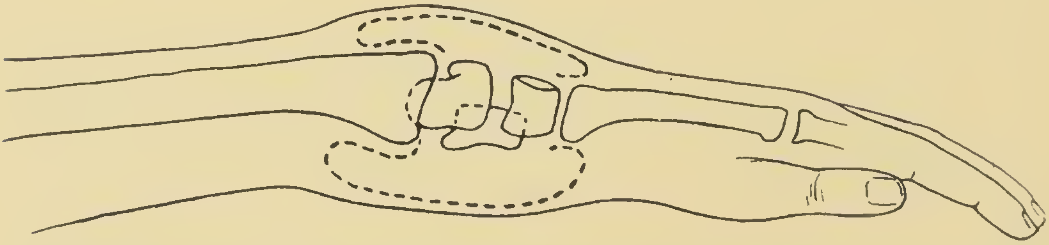

FIG. 88.—The dotted outline represents the swelling due to tuberculosis. It is shown too prominently in front, where it is hidden by the tendons, &c. The posture is characteristic.

The position of the thumb is peculiar; it is kept closely applied to the side of the index finger, it looks thin and useless, while all the fingers become pale, thin, and look fragile. The wasting of the interossei is very marked, and the forearm muscles atrophy to a considerable degree, contrasting sharply with the healthy forearm. There is definite but mild *palmar flexion* at the wrist, and the hand is kept midway between pronation and supination with just a tendency to pronation.

The elbow is held close to the body, and the usual free movements at the wrist are absent, and if the patient has to move the hand for any object he generally does so at the elbow-joint, *i.e.*, he uses the whole forearm, the wrist being held rigid. Often the hand and wrist are supported by the other hand. Great dread of movement at the wrist is experienced.

When abscess forms it is easily diagnosed from its superficial position ; it generally ruptures on the dorsum at the sides of the extensor tendons, but there is frequently a sinus on the front of the wrist towards its outer margin ; the abscess has an irregular ramifying cavity when it is extensive.

Treatment.—All authors agree in the advice to endeavour to avoid operation, as the functional results are most unsatisfactory, and deformity with grave interference with the use of the hand follows, or a flail-joint results.

Unfortunately, the outlook is largely dependent upon the associated lung lesion, and if wrist tuberculosis develops in childhood the life expectation is short. In adults the same, only to a graver extent, holds good.

Fortunately, Bier's method gives excellent results in wrist cases, and in my experience the iodoform-glycerine enhances its value. Early incision of swellings with the use of the suction-glass is to be followed.

In the usual methods of treatment the tendon sheaths are very frequently involved, but Bier's congestion almost certainly obviates this unless the amount of disease is very great or of marked virulence.

For purposes of fixation and rest, poroplastic is most satisfactory, or the splint apparatus designed by Lister to be used after excision of the joint may be used. In all cases the thumb and fingers must be left free, and the tendency for *palmar displacement* of the carpus provided against. In no joint is the general treatment and strict attention to the hygiene of the mouth and gastro-intestinal tract more important, as also the removal of all sources of sepsis.

Sanatorium treatment is of the greatest value.

The use of the fingers and thumb are to be encouraged *even in the worst cases*, as much of the evil after-results are dependent upon the matting of tendons —or their destruction—while the value of a movable thumb is incalculable.

If ankylosis is inevitable some dorsi-flexion at the wrist should be secured.

Deformity is corrected by adjustable splints or plaster-of-Paris.

In grave cases in adults, which are not progressing under Bier's methods and iodoform-glycerine, or in which there is *extending* suppuration, amputation is the best treatment.

SACRO-ILIAC TUBERCULOSIS.

Except when associated with disease of the lumbar spine, this is one of the comparatively rarer conditions. It is generally found in young adult life, but may be seen in youth or middle age, and not infrequently in patients suffering from some other tuberculous lesion.

Occupation is a factor in inducing the disease; horse-riding and some forms of athletics conduce to it, while severe jars applied to the tuber ischii and excessive strains are predisposing factors; in this latter sense probably parturition should be placed.

The ala of the sacrum or the ilium may be primarily affected. In youth the synovial membrane is said to be primarily affected. Caries sicca is often observed here.

Signs and Symptoms.—These are at first insidious and inconstant, difficult to localize.

Briefly they consist of—

(1) Pain.
(2) Lameness.
(3) Apparent lengthening of the limb.
(4) A special attitude.
(5) And when breaking down, *swelling.*

The earliest is PAIN, which sooner or later becomes constant.

It may be *local or referred.*

The *local pain* is over the joint; it is made worse on movement or pressure, or any severe form of strain; coughing, and defæcation increase it.

ESPECIALLY *is it increased by either compressing* *firmly the sides of the pelvis or by pulling apart the antero-superior spines.*

The *referred* pains are often very indefinite, and resemble those of sciatica, lumbar caries, or hip disease. The proximity of the lumbo-sacral cords explains the direction of these pains.

Shooting pains may develop which radiate into the loin or buttocks ; sometimes they shoot into the pelvis, and may be mistaken for rectal or vesical pains ; these shooting pains are most marked after prolonged rest, therefore appear first thing in the morning when the patient gets up ; they soon subside, however.

Weakness or inability to stoop and ascend stairs, &c., followed at a later stage by a sense of insecurity, as if something were loose and the body felt falling apart (sometimes experienced), and is probably connected with softening of the ligaments.

Tenderness over the sacro-iliac joint—normally represented by a dimple or depression—is constant, and when associated with increase of pain on compressing the ilium or stretching the antero-superior spines is probably pathognomonic.

It is stated that tenderness may also be elicited *per rectum.* When abscess exists this mode of examination is of the highest value.

The pain and tenderness increase when *abscess forms,* and then either a *swelling* appears dorsally, which is first manifest by obliteration of the sacro-iliac depression, or an appearance of puffiness exists, or an examination *per rectum* will elicit some fulness, tenderness, and pain high up.

The radiating pain may also increase and affect the buttock, thigh, or rectal region.

There is generally some increase in the local temperature, *i.e.*, heat.

As the disease progresses a deformity appears, or a peculiar posture is assumed.

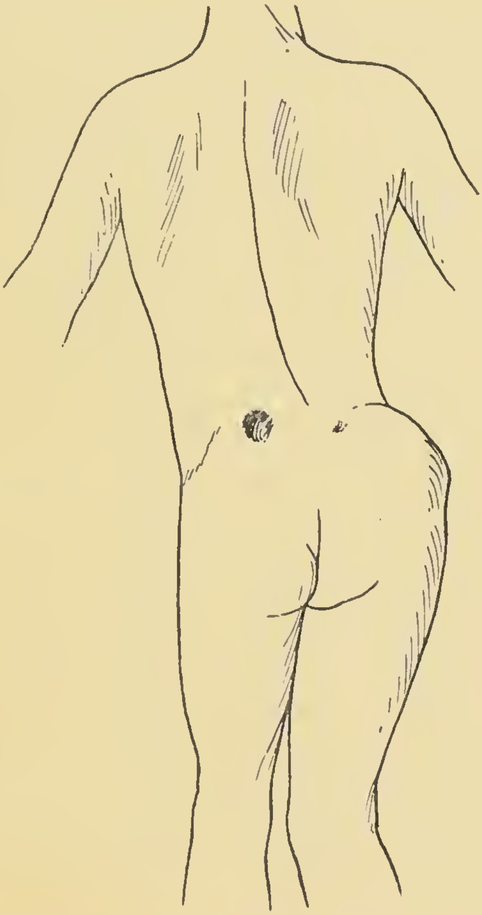

FIG. 89.—The typical posture in sacro-iliac tuberculosis. The right is the diseased joint. (From a photograph in Young's "Orthopædic Surgery").

Thus the *spine* and whole trunk is tilted to the sound side, the affected ilium is pushed outwards and forwards and looks prominent. The affected *limb appears lengthened.*

The *gait* becomes suggestive. Thus, the patient walks on the toes and limps; he moves cautiously and slowly, and in severe cases with considerable difficulty or shuffling. Although the limb appears lengthened, measurements in the recumbent position show it is only apparent, not real.

If the pelvis is fixed firmly, passive hip movements are practically unchanged, but in active movements during walking, when the counteraction of the thigh muscles exercises traction on the pelvis, pain results, and instinctively the movements at the hip are restricted.

Although atrophy and spasm of muscles other than from want of disuse occurs, this is often obscured by the posture. There is definite flattening and hardening of lumbar and buttock muscles.

In the earlier stages some wasting of the thigh muscles appears, which is moderate, and chiefly associated with disuse, later it may be marked.

Occasionally swelling of the thigh occurs; this is usually due to pressure by an abscess on the iliac veins.

When the later stages are reached the patient flexes the thigh and locomotion is impossible; he then lies in bed on the sound side to relieve the affected joint from pressure.

Abscess occurs in about 50 per cent. of the cases. As the sacro-iliac ligaments are of unequal density, and pus invariably follows the line of least resistance, the thin anterior sacro-iliac ligament gives way early, and this decides the direction of the abscess, aided also by gravity, so that the greater number of these abscesses take an intra-pelvic course at first; they may, however, again become *extra*-pelvic, either by burrowing upwards and opening in the loin about Petit's triangle, or, passing downwards, they follow the structures leaving the pelvis by the greater or lesser sacro-sciatic notches, and thence continue to travel downwards into the thigh; oftenest they find an outlet at the margins of the glutei.

While in the pelvis they may fill the iliac fossa and point above Poupart's, or travel down under the latter into Scarpa's triangle and appear in the thigh; or they may track downwards along the vessels or rectum, and either burst into one of the hollow viscera, or, passing through the pelvic fascia, gain access to the ischio-rectal fossa.

The table reproduced from Young's "Orthopædic Surgery" gives a good classification of the different routes taken:—

- Extra-pelvic
  - Point over the joint.
  - Track upwards and point in lumbar region.
  - Track downwards and point in gluteal region.
- Intra-pelvic
  - *Burrow upwards* into lumbar region.
  - *Burrow outwards and forwards*
    - Under the periosteum of pelvic fossa.
    - Under ilio-psoas
      - Remain loculated.
      - Pass under Poupart's.
  - *Burrow downwards*
    - Through sciatic notch
      - Point through the glutei.
      - Down into thigh.
    - Inwards towards ischio-rectal fossa
      - Point *per rectum.*
      - ,, ,, *perineum.*
      - ,, ,, *anum.*

EXAMINATION of the iliac fossa, and *per rectum* or *per vaginam*, should always be made.

Not infrequently stenosis of the rectum results from fibro-cicatrical thickening without pus formation, and symptoms of peri-rectal abscess precede the bursting of pus when this forms.

The formation of an abscess is always associated with marked general disturbance and increase in all the local symptoms.

The DIAGNOSIS rests between :

(1) Other forms of arthritis of the joint.
(2) Lumbar caries.
(3) Hip disease.
(4) Sciatica or lumbago.

Caries of the Spine.	*Hip Disease.*
Girdle pain.	The marked atrophy of the thigh and gluteal muscles.
Local tenderness over a spinous or transverse process.	Early limitation of movements.
Prominence of spinous process.	The site of the pain on pressure or jarring.
Tendency to great rigidity and spasm of erector spinæ.	The deformity or posture peculiar to the disease.
Posterior curvature later.	The inability to sit in the tailor's attitude.
Limitation of movements of the spinal column and freedom of movements of the hip even when the pelvis is not fixed.	Pressure on the trochanter produces pain, whereas compressing the ilium does not (unless the acetabulum is gravely involved).
Equality of limbs.	X-rays.
Younger age of the patient.	
Compression or "bursting" of the ilium has no effect on the pain.	
X-rays.	

Sciatica, which may be itself due to disease of the sacro-iliac articulation, must be excluded by the discovery of osteo-arthritis of the spine, hip or sacro-iliac joint.

By its chronicity, when established, and its selection of older patients, the mode of onset and history.

The various specific symptoms.

The referred pains, due to sacro-iliac disease, never produce such a marked sciatica as to extend down the whole length of the leg.

X-rays.

Lumbago is usually higher up, BILATERAL, is made worse by extension or flexion of the back; there is considerable tenderness on pressure over the erector spinæ, but deep massage relieves the pain. The lower limbs are equal; the posture of the patient is that of lordosis, with bending forward of the whole body.

The duration is usually a few days, but it may be more chronic; it is relieved by treatment by heat, friction, and anti-rheumatic remedies, and PURGATIVES.

X-rays.

Other forms of arthritis are usually more acute, and there is evidence of a definitely associated lesion elsewhere, gonorrhœa, septic infections, &c.

Osteo-arthritis.—On examining *other* joints, evidence of grating, lipping, and other symptoms appear; the patient generally is "rheumatic," and has some chronic septic process of one of the mucous tracts. Not infrequently there is lipping or thickening of the ilium; abscess never forms, but effusion of a very small degree may simulate it; generally the *sacro-iliac fossa or dimple is exaggerated in osteo-arthritis.*

In the dry forms of sacro-iliac tuberculosis the diagnosis is more difficult, but the general signs and symptoms are quite definite.

The *prognosis* of the dry form is better than of the suppurative, but the modern methods of treating the disease have diminished the danger of the latter, also we endeavour to convert it into the dry form ; but when the abscess tracks into the pelvis and various complicated positions the dangers must be enhanced considerably.

The great readiness that formerly existed to immediately operate in these cases greatly aggravated the dangers, especially as it was customary to drain and pack the wounds.

The fact is always lost sight of that a tube will conduct down virulent cocci from the skin with greater facility than it permits escape from the depths.

Also that gauze acts as a drain for a very few hours only ; then it is a foul, septic, foreign body, and even acts as a cork or plug.

The mere cessation of the use of tubes and gauze in treating tuberculous collections is a great advance, and if the wounds are submitted to the influence of suction they escape being MADE septic, but instead remain sterile and heal as sterile wounds.

The use of a Volkmann's spoon in the treatment of *bone* tuberculosis was another mistake of former days ; if all the disease is to be removed, a gouge or bone-cutting instrument is absolutely necessary.

Failure to prevent continued activity by the sharp spooning of bony foci was natural ; *the disease was not removed*, but only the most advanced portions of it. When sacro-iliac abscesses which opened dorsally were treated in the foregoing manner, septic osteo-myelitis always occurred and the double infection led to very fatal results.

The dangers of the pelvic abscesses still are in proportion to the degree of septic infection.

Young states: "Death from prolonged suppuration is exceedingly rare when tubercular abscesses are subjected to the 'let alone' treatment, and rarer still is death from septic infection." If this is so without the use of suction hyperæmia, I am quite sure it is more true when the latter is used.

Yet in his treatment Young carries out tamponage with gauze, he curettes the abscess cavity, and in short carries out the very treatment one condemns.

Treatment.—At the risk of burdensome repetition I must again state that the best results in tuberculosis depend upon the state of the gastro-intestinal tract, the absence of sepsis therein, and in other parts of the body.

Good nutritious meat diet, a healthy mouth, stomach, and intestine, sound general hygiene, with a considerable amount of the "let alone" treatment is *the* treatment of surgical tuberculosis.

At first it is much wiser to keep the patient in bed with slight weight extension and with the body kept at rest between sandbags, say for two months; then a double Thomas's splint with a pelvic bandage may be fitted so that he may be carried into a spinal carriage.

A mattress with a removable section is of the utmost service in the treatment and nursing of cases rigidly confined to bed.

The patient should have all the outdoor treatment possible, wearing a double Thomas's splint, or a leathern or poroplastic pelvic splint, or fixed in a Phelps's box.

Plaster-of-Paris will effect perfect immobilization of the pelvis, and is cheap, but has many disadvantages.

In the *early stages* repeated counter-irritation is serviceable.

But above all in value is the use of a properly-fitted suction glass for use in the usual manner daily.

This can be used while the patient is confined to bed, or later when he is permitted to get about on crutches.

After six to eight months in bed and in the spinal carriage, and when all spasm of muscle and deformity is corrected, and if the progress made justifies it, a pelvic splint or a *single* Thomas's hip splint may be fitted and the patient get about on crutches, with a patten on the sound side.

But if the condition lags or is getting worse in spite of the suction-glass, &c., then ʒii to ʒiii of iodoform-glycerine should be injected into and about the joint, and rest in bed enjoined. Later the area is blistered once vigorously, and when this has subsided small flying blisters are applied to keep up the hyperæmia. When the symptoms permit he may get about again, but at first in a spinal carriage with a *double* Thomas's splint on, later wearing a single Thomas's and using crutches.

Repeated X-ray examinations give definite information of the bony changes.

If there is any reason to suspect an abscess, and this is tracking backwards, it should be aspirated and iodoform-glycerine injected to the amount of about a quarter the pus removed, and a firm dressing applied; this may need repeating two or three times: or an incision made, the contents squeezed out gently, and a suction glass used daily and continued long after it has healed.

If, however, the abscess *lies anteriorly* it must *not be allowed to track*, but an operation to permit of its dorsal extension carried out.

An incision 3 in. in length is made in a curved direction, the centre of the imaginary circle it forms being just below the post-superior iliac spine; the lumbar and gluteal muscles with the periosteum are rugined off the bones and the contiguous part of the ilium removed (*i.e.*, both spines and adjacent bone), and if necessary part of the ala of the sacrum, with or without the joint, is freely chiselled away; the object is to provide free means for the abscess to point backwards.

The wound *is entirely closed*, and as soon as the skin is united (or even before this if it is carefully done), the suction glass is used.

When the wound is open it is often advised to fill the cavity with iodoform-glycerine, but it is much wiser to secure healthy union of the skin first; *an intact skin over a tuberculous focus is of the utmost importance.* A week after the wound is firmly healed iodoform-glycerine may be used, and a moderate degree of distension attained for ten minutes before the excess of fluid is allowed to flow away.

This treatment—*i.e.*, the suction glass, fixation of pelvis and limb, occasional iodoform-glycerine—after a portion of bone has been removed to allow of easy dorsal tracking, will usually prevent the burrowing which is so dangerous, and lead to a cure of the disease.

If sinuses exist they must be treated by iodoform-glycerine and suction.

Dense sequestra supply the second imperative indication for operation.

Pelvic abscesses must be opened *via* the ischiorectal fossa, and iodoform-glycerine injections used. The incision must not be packed, but defæcation must be so conducted as to avoid infection. It is wise to strap the incision previous to the action of the bowel; the strapping is removed after the parts are cleansed.

TUBERCULOSIS OF THE SPINE.

The spine may be said to be a series of joints. The bodies of the vertebræ, like the long bones, have each an epiphysis above and below, contiguous to the joint cavity as represented by the inter-vertebral discs.

The anterior and posterior aspects of the bodies are united together by the anterior and posterior common ligaments, which run as longitudinal straps along the front and back of the vertebræ and are tacked fast to the *inter-vertebral discs* and *epiphyses only*; the posterior being in the spinal canal, therefore intervenes between the bone and the spinal meninges.

These ligaments are firmly united to the inter-vertebral discs and the epiphyses of the vertebræ, but are only loosely attached to the actual hollowed-out bodies of the bones; thus they form arches under which pass small blood-vessels.

They are thick in the midline and fade off at the sides, where they terminate indefinitely; or, in the case of the anterior common ligament, become continuous in the lumbar region with the sheath of the psoas.

Beneath the posterior common ligament lies a plexus of veins.

Lying on the anterior common ligament is the aorta; its intercostal and lumbar branches run at the sides of the vertebræ, embracing the bones; when these divide into two, the dorsal vessel passes backwards between the adjacent transverse processes, and there is joined by the dorsal division of the intercostal or lumbar nerve; and together they pass into and between the divisions of the back muscles, to become cutaneous.

The upper six thoracic branches become cutaneous within an inch of the midline. The lower six thoracic appear at an increasing distance from the midline, *i.e.*, along the outer side of the mass of muscles lying at the side of the spine, and corresponding to the angles of the ribs.

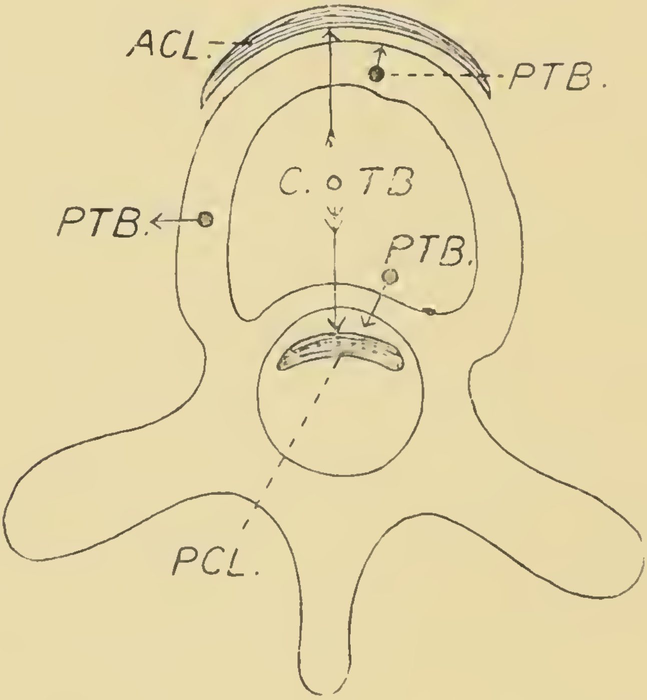

FIG. 90.—A dorsal vertebra from above. *ACL.*, anterior common ligament; *PCL.*, posterior common ligament (in the spinal canal): *CTB.*, central focus of tuberculosis; *PTB.*, peripheral foci of tuberculosis. The arrows indicate the lines of extension of the disease.

It is along these nerves and vessels that pus tracks when it forms a dorsal abscess, *so that high up in the dorsal region abscesses appear* CLOSE *to the spines;* in the *lower dorsal region they appear two or more inches further away.*

The anterior primary divisions of the *intercostal arteries and nerves* pass outwards between the two intercostal muscles, and if pus follows along them it points somewhere along the side of the body, not infrequently in the axillary line.

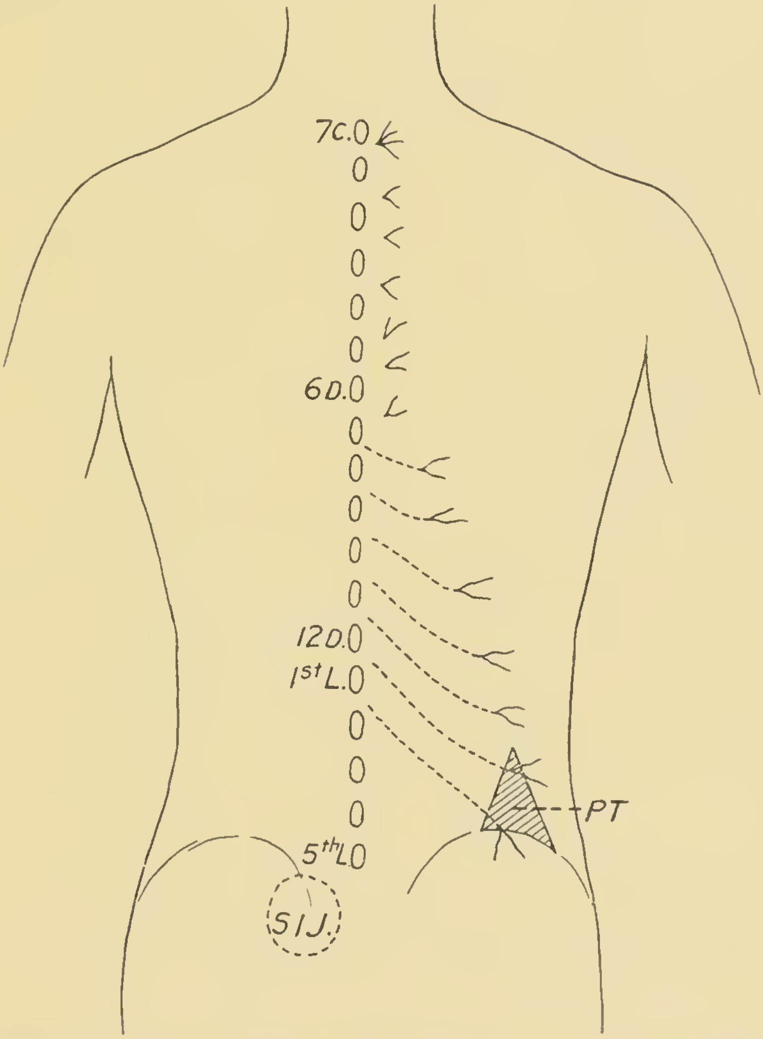

FIG. 91.—The points of emergence of the dorsal nerves and vessels, along which abscesses originating in the spine track become subcutaneous (see text). *PT.*, Petit's triangle ; *S/J.*, sacro-iliac joint.

In the *lumbar region* the posterior primary divisions pass backwards between the transverse processes and become cutaneous at the *outer edge of the erector spinæ muscles,* thus acting as guides along which lumbar abscesses track and point.

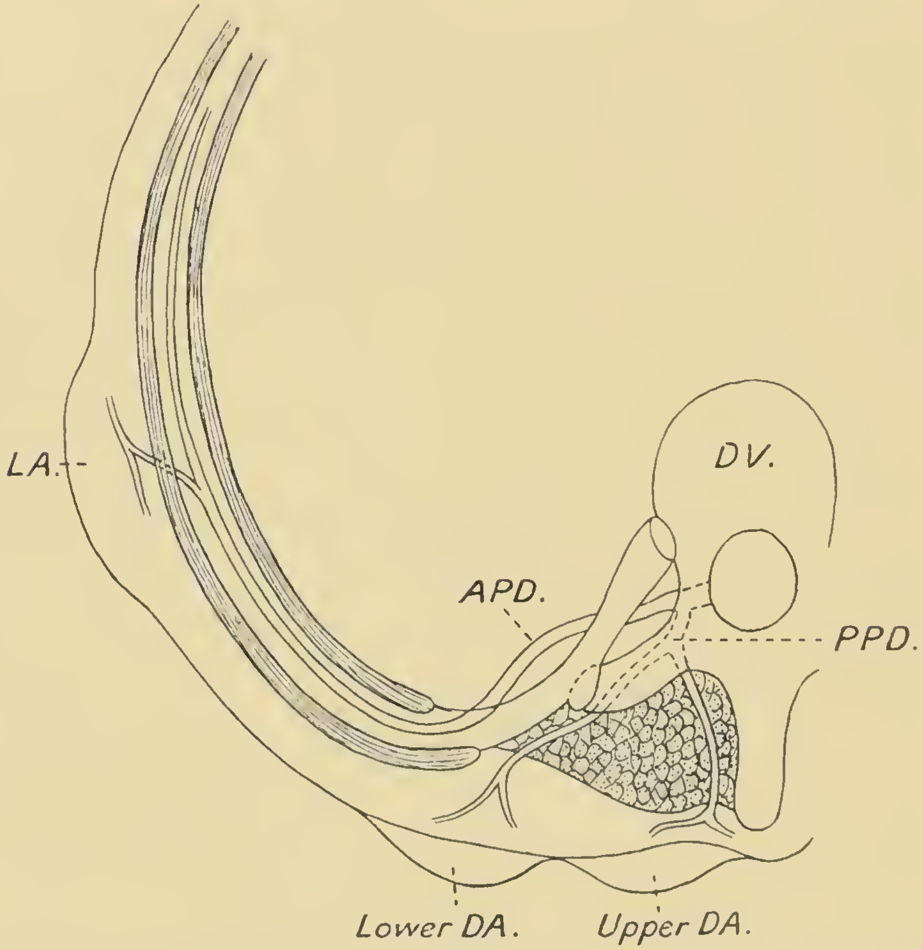

FIG. 92.—Diagrammatically represents the course of an intercostal nerve, and the formation of subcutaneous abscesses where the nerves become cutaneous. *PPD.*, post-primary division; *APD.*, ant.-primary division; *Upper DA.*, site of abscess from caries of upper sixth dorsal vertebræ; *Lower DA.*, site of abscess from lower sixth dorsal and upper lumbar caries; *LA.*, site of abscess which has followed the ant. primary division.

The anterior primary divisions pass into and through the psoas muscle, and *so conduct pus into the psoas sheath* (see Abscess, later).

If pus forms in the bodies of the dorsal vertebræ and reaches the surface of the bones in front it *is* a mediastinal abscess, and if it does not track along the intercostal vessel and nerves and thus point on the surface of the trunk, it is possible for such an abscess to burst into the trachea, or lungs, or even the œsophagus.

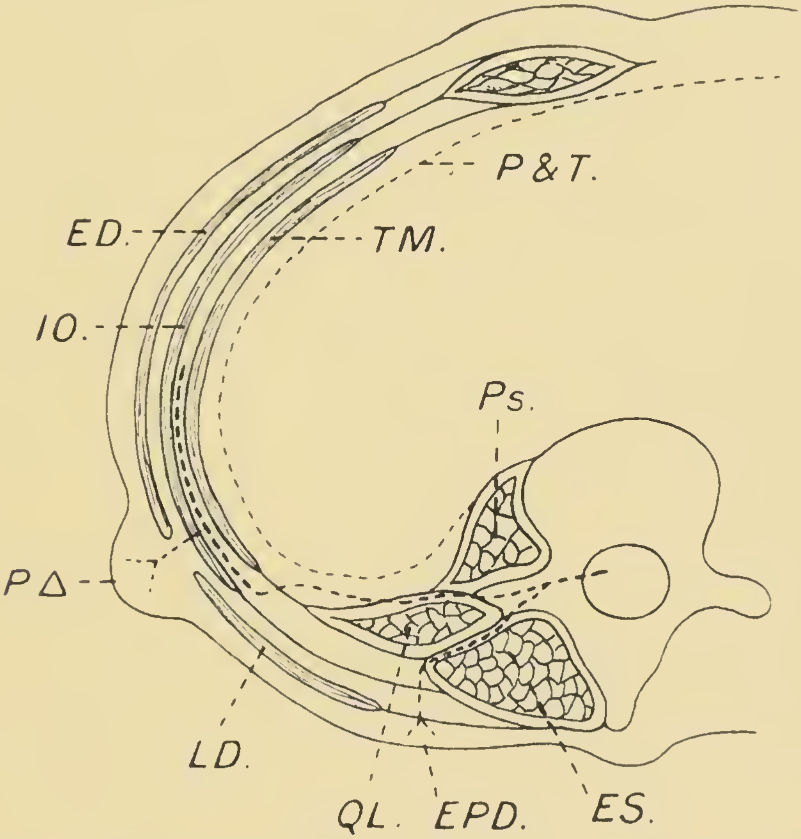

FIG. 93.—A section to indicate the course of the 12th dorsal nerve and the points where abscesses appear ; *Ps.*, psoas muscle ; *ES.*, erector spinæ ; *QL.*, quadratus lumborum ; *LD.*, latissimus dorsi ; *TM.*, transversalis ; *IO.*, internal oblique ; *ED.*, external oblique ; *P & T.*, peritoneum and transversalis fascia ; *EPD.*, the external branch of post primary division (see fig. 92) ; *P*△, Petit's triangle and abscess.

As a rule, however, sooner or later they come to the surface, sometimes indeed at a great distance from their source of origin, and may be mistaken for caries of a rib or sternum.

In the cervical region the anterior common ligament becomes continuous with the *pre-vertebral layer of cervical fascia.*

On this layer lies the pharynx and the sheath of the carotids. It joins the sheath of the sterno-mastoid at the circumference of the neck AT ITS POSTERIOR MARGIN.

Thus any effusion forming on the front of the upper cervical vertebræ *is* a retropharyngeal abscess; if it tracks laterally it usually appears in the posterior triangle behind (*i.e.*, posterior to) the sterno-mastoid muscle.

It might track along the carotid sheath and finally burrow in front of the sterno-mastoid; this, however, is not of frequent occurrence.

It must be remembered that the transverse process of the ATLAS lies between the tip of the mastoid process and the ramus of the jaw at the level of the lobule of the ear, where it can be felt as a hard resistance, pressure on which evokes a peculiar tenderness, so that an abscess (*i.e.*, cervical) situated high up *may* point in front of the sterno-mastoid, or it may track upwards through the foramen magnum.

PATHOLOGY.

There is nothing specific to be said *of the pathology of spinal caries.* In the dorsal and lumbar regions, it is a rarefying osteitis, beginning usually at the epiphysial line, or under the periosteum, but its primary focus may be quite central.

The central and sub-epiphysial origin is more common in children and tends to remain as a dry caries.

The subperiosteal variety occurs in older subjects, and is almost always associated with abscess.

The central varieties become subperiosteal ; likewise the superficial form may burrow inwards between the disc and bone, and secondarily infect the bodies.

In the *cervical region*, especially when it affects the first and second cervical, it is thought that it usually begins as a synovial infection.

When *the tuberculosis begins in the body of a vertebra its effects depend upon the direction the osteitis extends in*, which may be in three separate ways :—

(1) *Vertically :* Thus the disease may involve the intervertebral discs, perforate them or lead to separation of disc and bone ; if the disc is perforated the adjacent vertebra is involved.

(2) *Forwards :* (*a*) As in the first instance, the plane between disc and bone may offer the line of least resistance for the forward extension.

(*b*) But oftenest the interior of the bone rarefies with or without sequestrum formation, and a shell remains ; finally the shell is perforated and the disease reaches the surface of the bone either directly in front under the anterior common ligament or at the sides of the bodies.

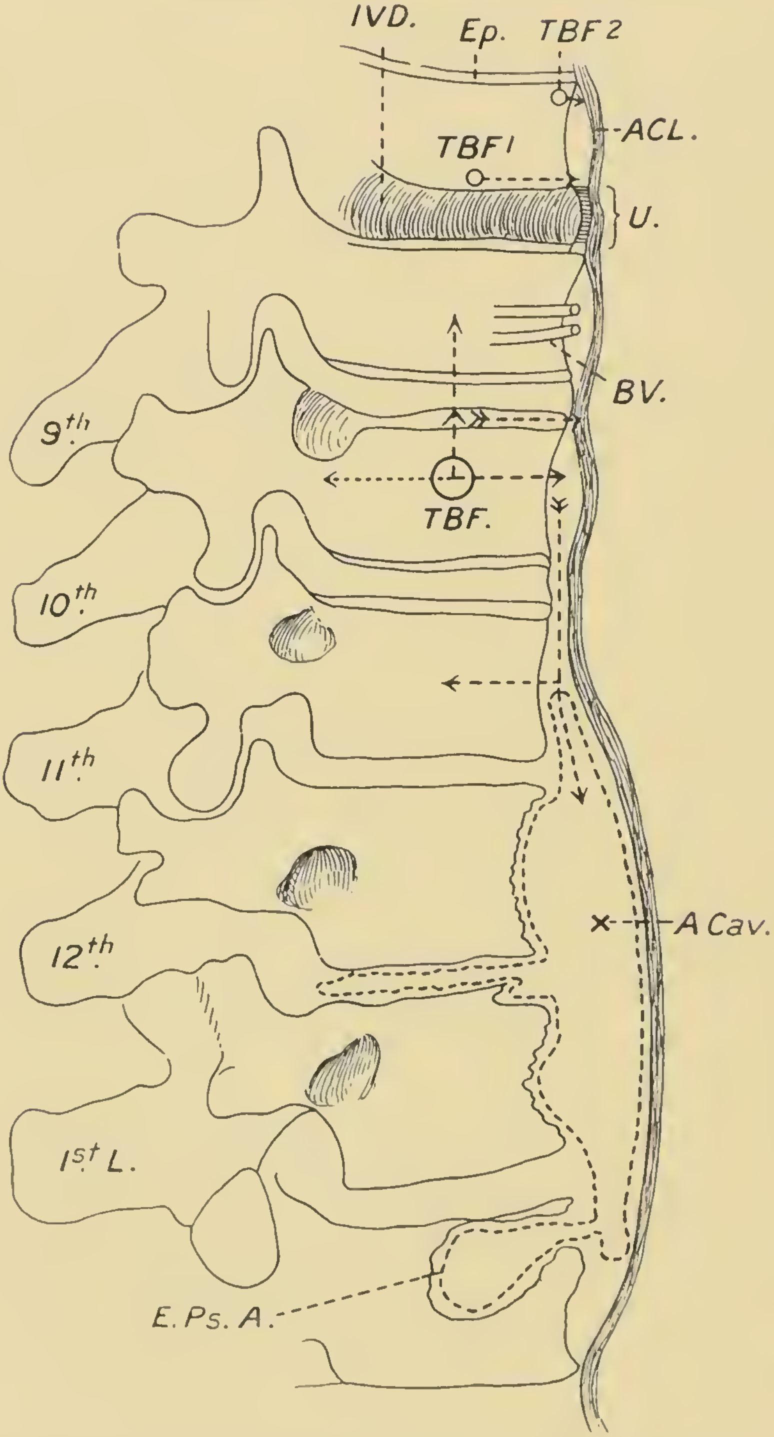

FIG. 94.—Represents the foci of origin and course of tuberculosis in the spine (see text); *Ep.*, epiphysis; *IVD.*, intervertebral disc; *ACL.*, anterior common ligament; *U.*, attachment of *ACL.* to epiphyses and disc; *BV.*, intercostal vessels; *A Cav.*, an abscess cavity, its mode of origin from above and its ramifications; *E. Ps. A.*, abscess extension likely to become a psoas abscess; *TBF.*, a central focus and its lines of spread; *TBF*[1], a juxta-epiphysial focus and line of spread; *TBF*[2], a subperiosteal focus, usual in adults, and often associated with abscess.

The further behaviour of the disease on the surface is as follows:—

(1) Finding a fascial plane formed by the anterior common ligament, it may extend upwards or downwards over four or five vertebræ, only lightly involving their surfaces and stripping off the anterior common ligament.

(2) The circumferential inflammation tends to localize the process to the surface of the bone primarily involved and a local abscess forms; sooner or later it enlarges and extends (1) *longitudinally*; (2) *laterally*.

If *longitudinally*, it depends upon circumstances how far it proceeds, usually only over one or two vertebræ; then involving the surface of these it may burrow deeply into the bodies and again excavate one or more.

If *laterally* it follows the course of a muscle, artery, or nerve. If it strikes the posterior primary divisions of the intercostal or lumbar vessels and nerves it appears as an abscess on the dorsal aspect of the trunk.

If it follows the anterior primary divisions along their course in the thorax, it becomes intercostal and then finds an outlet somewhere along the axillary line: in the *lumbar region*, and when the twelfth dorsal vertebra is involved the origin of the psoas muscle complicates matters, so that even when an abscess reaches the front or sides of the lumbar vertebræ the tuberculous process almost always does involve the psoas, but it *may* soon leave the muscle along the posterior primary divisions and become a lumbar abscess opening at the external border of the erector-spinæ muscle, or it may follow the anterior divisions, *i.e.*, the lumbar plexus, and reach the surface about Petit's triangle half way along the crest of the ilium, where also at times sacro-iliac abscesses may open.

In the larger number of cases, however, the pus is confined beneath the psoas sheath, and the psoas becomes converted into an abscess sac, and the pus burrowing downwards may reach and fill the iliacus sheath, thence again occasionally to rupture *above* the iliac crest, but far oftener to point just above Poupart's near the anterior-superior spine, or passing downwards along the ilio-psoas tendon appear in the thigh and point inside or outside the femoral vessels.

Caries necrotica is quite common in lumbar caries, and when there are gross sequestra they probably are due to infarction.

(3) *Backwards:* Here, instead of reaching the front or sides of the bodies, the back of the vertebral bodies is perforated, the disease appearing in the spinal canal. At first the granulation tissue or pus lies between the bones and the *posterior* common ligament, the latter often bulging against the spinal membranes. As before stated, the pus may extend longitudinally over several vertebræ, but the commonest course is to involve the posterior-common ligament and the meninges in the tuberculous process, which may or may not break down into pus—in either case giving rise to compression of the spinal cord, with or without diffluent softening, from vascular disturbance and toxic irritation, or to a transverse myelitis and tuberculosis of the actual cord.

In a large number of cases the tuberculous process extends as a periostitis or a meningitis into the intervertebral foramina, and thus produces *severe nerve-root symptoms* either by pressure or by a neuritis.

The exact conditions of the spinal meninges and spinal cord influence considerably the prognosis of the paraplegia which arises; although, on the whole, this is exceedingly favourable under palliative measures.

In any case, when the body of a vertebra becomes softened from dry caries or caseation, the superincumbent weight—that of the head and neck, the upper thorax and arms—tends to crush the bones; and herein lies the key to successful treatment, *i.e.*, *the crushing must be prevented.*

The crushing affects the bodies chiefly in the anterior half; the strong pillars formed by the intact articular processes at the posterior part of the bodies resists the crushing; so the *front of the vertebræ* give way, and the vertebral column above the lesion is bent forwards like a broken stick.

Below the crushed vertebræ there is some tendency for the spine to incline backwards to help maintain the equilibrium.

Thus, in addition to a prominent spinous process, there is a definite angle in the spine, where the slightly backward inclined lower part meets the forward inclining upper part.

The acuteness of the actual angle depends upon (1) the degree of crushing; (2) the number of vertebræ involved.

Thus, if only one or two bodies are crushed, there is an actual acute angle; while, if there is some degree of absorption and only slight crushing of three or four vertebræ, a broad curve is developed; the angle, however, in all cases is more localized and acute than that developed by kyphosis.

When the sides of the bodies become carious and give way a severe form of *lateral inclination* or deviation occurs ; this is, to some degree, compensated for by curves in the vertebræ below and above, and so a scoliosis develops, the prognosis of which is more grave than the ordinary static scoliosis.

Occasionally actual dissociation of the inter-vertebral discs occurs, and a form of dislocation ensues which is marked by "a peculiar deformity characterized by extreme bony projections (of the spinous processes) which replace the angular curvature". (Young).

When the neural arches (*the laminæ and pedicles, or spinous process*), *are involved*, they usually result in scoliosis, with abscess formation, the signs and symptoms of which are much more superficial and local.

Occasionally dense sequestra result.

The *predisposing conditions* are those which favour tuberculosis generally ; the erect position of human beings transmits shocks and trauma to the vertebræ in a manner impossible among animals, in whom caries of the spine is much less frequent.

Age and Sex.—It is commonest in onset before puberty, and affects females more frequently than males. There is generally some associated tuberculous lesion ; lymphatic glands especially have been or are involved, while the family history of tuberculosis is strong. Extension of disease to the lungs or abdominal viscera is frequent.

Regions involved, in order of greatest frequency, are as follows :—

(1) Lower dorsal region, especially ninth and tenth vertebræ.

(2) Lumbar, fourth and fifth.

(3) Cervical, first, second and third.

In the *dorsal region*, besides the ninth and tenth, the upper dorsal (*i.e., fourth*) and the mid-dorsal (the *eighth*) vertebræ are often involved, so that the thoracic vertebræ are involved in 50 to 65 per cent. of all cases of caries of the spine.

When the lower part of the lumbar vertebra (fifth) is involved a condition called Spondylolisthesis is developed, which in females leads to a deformity of the pelvis of the utmost importance, as it conduces to abnormal attitudes of the fœtus and great difficulty in parturition.

PROGNOSIS AND COURSE.—With early and correct treatment the prognosis as regards recovery is excellent, and even severe paraplegia may be completely recovered from.

When the disease ceases and repair occurs the granulation tissue becomes fibroid, calcification and ossification follows, and the adjacent vertebræ are welded together by ankylosis and newly-formed osteophytic buttresses derived from osteoplastic periostitis and the repair of the excess of granulation tissue.

During the progress of the disease osteophytes often form at the margins of the bones, and repair is an extension of this process. If the osteitis has not extended to the surface repair takes place by reformation of bone.

Caseous masses liquefy and are absorbed. If dense *sequestra* exist they generally are associated with abscess formation, and undergo very slow disintegration and come away in the pus. Occasionally they are infiltrated with healthy granulation tissue and gradually destroyed by osteoclasts.

As a rule they form in the lumbar vertebræ, and in this position, if they do not come away, may with some certainly be removed by operation (Treves's operation).

The articulations and spinal arches generally undergo firm ankylosis; the joints may synostose and the ligaments of the arches calcify.

If an abscess exists it may entirely disappear by absorption of the liquid portion, the caseous material may long remain encapsuled by dense fibroid tissue (residual abscess), and then gradually disappear by absorption, or it may calcify.

It unfortunately forms a suitable nidus for pyogenic infection, and may give considerable trouble again. As it is highly probable the tubercle bacilli it contains are not dead, a very mild pyogenic infection may restart the caries.

On the other hand, diffuse tuberculous spinal or cerebral meningitis may be set up and produce a rapid termination; pressure on and involvement of the medulla may occur. Œdema of the glottis and asphyxia may take place.

The abscesses may become septic and lead to septicopyæmia.

Extension to other organs or miliary tuberculosis may arise.

Or when paraplegia occurs septic catheterism may lead to acute infection of the genito-urinary system, or bed-sores of a serious nature may carry off the patient.

A very rare mode of death is that due to compression or destruction of the medulla when the odontoid process of the axis or the transverse ligament of the atlas are damaged and dislocation forwards of the head and atlas occurs.

Occasionally this may be a gradual process, and the compression be of a subacute variety, to end by sudden death, or when properly treated and neckpiece and jurymast worn for a prolonged period recovery may ensue.

Symptoms and Signs :—

Premonitory.
Pain and tenderness.
Limitation of movement : rigidity.
Spasm and atrophy of muscles.
The attitude.
Deformity.
Abscess.
Paraplegia.
X-ray examination.
Tuberculin tests.
General symptoms.

The *premonitory symptoms* are often very slight, and may be quite overlooked.

They consist in discomfort, aching, tired or bruised feelings in the back or neck, vague fleeting pains, disinclination to perform movements leading to bending of the spine. The patient becomes lethargic and lackadaisical, with disinclination to play, and begins to look pale and seedy ; if younger he is often very irritable and peevish, and cries when handled.

Sooner or later the **pain** *localizes* itself to some definite region in the spine.

It is aggravated by exertion, and to some degree relieved by the recumbent posture. All forms of jars and concussions bring it out, especially if associated with torsion of the spine. All forced movements likewise aggravate it.

Tenderness is always present, both to direct pressure or tapping of the spinous process, and especially on deep pressure *at the sides of the vertebræ*, just over the swelling produced by the muscles, which produces rotation of the vertebræ by pressure on the transverse processes.

In addition there often is *referred or nerve root* pain, which is usually of a shooting character.

Occasionally it is very misleading, especially in the case of children, as when low down in the dorsal region it is referred to the course of the nerves in the *abdominal wall*, and thus distracts attention from the spine.

In the upper dorsal and lower cervical region intercostal pain or pain referred down the arm may occur.

In the upper cervical region the pain is more diffuse, and is referred to the course of the cutaneous nerves in the neck or back of the head.

Also in the lumbar region sciatic or gluteal pain is complained of.

Limitation of movements and rigidity. This is a most important sign, and is elicited in older patients by asking them to bend forwards and touch the toes, or to hyper-extend the spine by bending backwards as far as they can.

Lateral movements, especially that of *twisting the spine*, must be tested. The pelvis is firmly fixed from behind, and the patient is told to look over the shoulders as far as possible, first over one side, then the other. It will be observed that—

(1) *If the disease is in the cervical spine* in any part, practically no movement takes place there, but the lumbar (and apparently the dorsal) region rotates freely,

but very cautiously, *i.e.*, the whole body twists, but least of all the cervical region, *which is the converse of the normal.*

If the disease lies in the *occipito-atlantal articulation* the patient cannot flex or extend the head (*i.e.*, nod), but keeps it rigidly fixed in a position of flexion, the chin approximated to the sternum.

Rotation can be performed painlessly but slowly, and it is restricted to some degree.

If, on the other hand, the disease lies in the *atlanto-axial articulation* flexion and extension is performed painlessly (but cautiously), while rotation is impossible or very painful.

If the disease lies in any lower part of the cervical spine, rotation of the head is free and painless, but rotation of the *neck* and head is restricted and painful.

If an attempt is made by the surgeon to press the head into any position the whole body "gives" to the pressure, while the head continues to maintain its relative position to the neck.

(See the Attitude and Deformity.)

When the disease lies in the upper dorsal region, where practically only flexion and extension are possible, these two movements are restricted, while the arm movements, especially such as call for rapid and free movement or great traction, produce pain; thus the patients cannot hang suspended by their arms, nor can they pull down window sashes.

In the *lower dorsal region* the same limitations exist.

In the *lumbar region,* where rotation of the body normally takes place, lateral flexion and twisting of the body is both painful and restricted.

If asked to pick up some object from the ground patients do not bend forwards as usual, but keep the back rigid and straight, and sink down by bending the hips and knees as one would, if asked to do so, when carrying a weight on the head, and with similar caution. In reverting to the erect posture they often assist themselves by "climbing up" their thighs, *i.e.*, they rest their hands just above the knees to support the spine.

In the case of little children it is necessary to test these limitations in a different manner; as a rule the cervical restrictions are readily seen.

It is said the child supports its head with its hands; this generally occurs, however, only in the very acute cases, and when the patient is asked to do forced movements of the lumbar or thoracic vertebræ (or when very tired), cervical movements are generally refused *in toto*.

The *dorsal and lumbar* rigidity is tested by laying the child prone on its face, then by taking hold of its ankles, and bending the legs, thigh, and pelvis backwards so lifting them off the couch, the child either cries out, or instead of bending the spine, as is the normal condition, to more than half a right angle, the spine is held rigid and straight, and the whole body is raised off the couch instead of bent backwards.

Usually, however, the child early shows marked objection to this proceeding.

Lateral flexion is ascertained in the same way by "slewing" the body round from the ankles; usually bending of the body to about one-third of a right angle is possible, but in these cases the whole body slides sideways in a very short time.

Associated with the limited movements is marked *rigidity*, *i.e.*, spasm of the spinal muscles.

These are firm, rigid, and prominent. As the disease progresses they **atrophy**, but the rigidity persists throughout.

If a child is placed across the surgeon's knees face downwards, arms and legs hanging down, the prominence and rigidity of the erector-spinæ is well brought out.

The **Attitude** assumed by patients when the disease is moderately advanced is often striking.

In the *cervical region* wryneck is a common attitude, also flexion with the chin dropped on the sternum and the eyebrows elevated. The back of the neck is flattened (see Deformity).

In the upper dorsal region the neck is pushed forward with the chin raised, the shoulders are drawn backwards and slightly elevated, and there is some degree of lordosis or marked flattening.

This attitude is involuntarily simulated when one stretches after having written for a long time with the head bent forwards, and the chest contracted.

In the *lower dorsal region* the attitude is rather that of the military "standing at attention," the spine is rigid, and shoulders squared.

Children frequently stoop forwards and grasp their thighs for support.

In the *lumbar region* the body is also generally supported by grasping the thighs.

It is said that when there is an unilateral psoas abscess "the patient stands on one leg, the thigh of which is flexed, the body bent forward, and one hand resting on or just above the knee."

The **Deformity.**—In the cervical and lumbar region where normally a concavity exists, *flattening* is characteristic, the concavity disappears, and in the lumbar region in later stages a convexity or angle develops.

In the neck, angles never appear, but the concavity is often replaced by a convex appearance, which, however, is usually due to the rigid muscles and the bending forward of the head.

The degree of angular deformity depends upon the number of vertebræ involved in the crushing-in and absorption, as has been explained on p. 403.

In the *dorsal region* an angular curve is the rule, with a pronounced prominence of one or more spinous processes. A SHARP MEDIAN ANGULAR CURVATURE IS ALMOST DIAGNOSTIC OF SPINAL CARIES. A curve or limited kyphosis may, however, exist (see p. 403).

The prominent spine in the dorsal region is always that of the upper of two diseased vertebræ, or of the normal vertebra *above* the diseased one, if there be but one bone involved.

This is readily understood, as the spinous processes in the dorsal region lie obliquely downwards, and when a body is crushed the spine of the vertebra above becomes horizontal, and so apparently longer, hence it projects.

In the *lumbar region* the prominent spine is that of the *diseased* vertebra ; for reasons the converse of what holds in the dorsal, the horizontal spine of the upper vertebra becomes oblique upwards and so apparently shortened, while the horizontal spine of the diseased bone remains prominent.

If only one body is diseased a sharp projection due to its spinous process may exist, the contour of the spine above and below being almost normal.

In the lumbar region, if only one bone is involved centrally, the periosteum may be hyperæmic and deposits bone on the outside, so forming a thick shell or buttresses which prevent the crushing in of the body and its resulting deformity, although abscess or sequestra and fairly extensive tuberculosis may be present.

At times a well-marked deviation of the spine laterally may be present ; it generally begins at a definite spot and is not unlike the big C curve of scoliosis. The degree of deformity becomes modified or hidden later by compensatory curves above or below the diseased area, developed in order to maintain the erect posture.

In dorsal caries the ribs and thorax, however, may undergo considerable deformity; the ribs are crushed together, the sternum becomes the typical pigeon chest, being projected and at times bent forwards, and not infrequently a deep horizontal groove forms over the lower false ribs.

Abscess.—In referring to the anatomy and pathology the course pus may take has already been indicated.

In these days such large abscess cavities as were formerly seen are rare, and as X-rays clearly show up abscess formation we now diagnose them at an early stage.

In the upper *cervical region*, first, second and third cervical vertebræ, a retropharyngeal abscess can be detected by visual inspection of the pharynx or by palpation of it. It forms a bulging of the posterior wall, generally more marked one side than the other, usually tense, firm, and elastic.

Swallowing is early interfered with, partly from pain, partly by impeded function of the constrictor muscles.

Breathing and speech become affected.

Œdema of the glottis not infrequently arises and may be the first observed symptom of pus in the region.

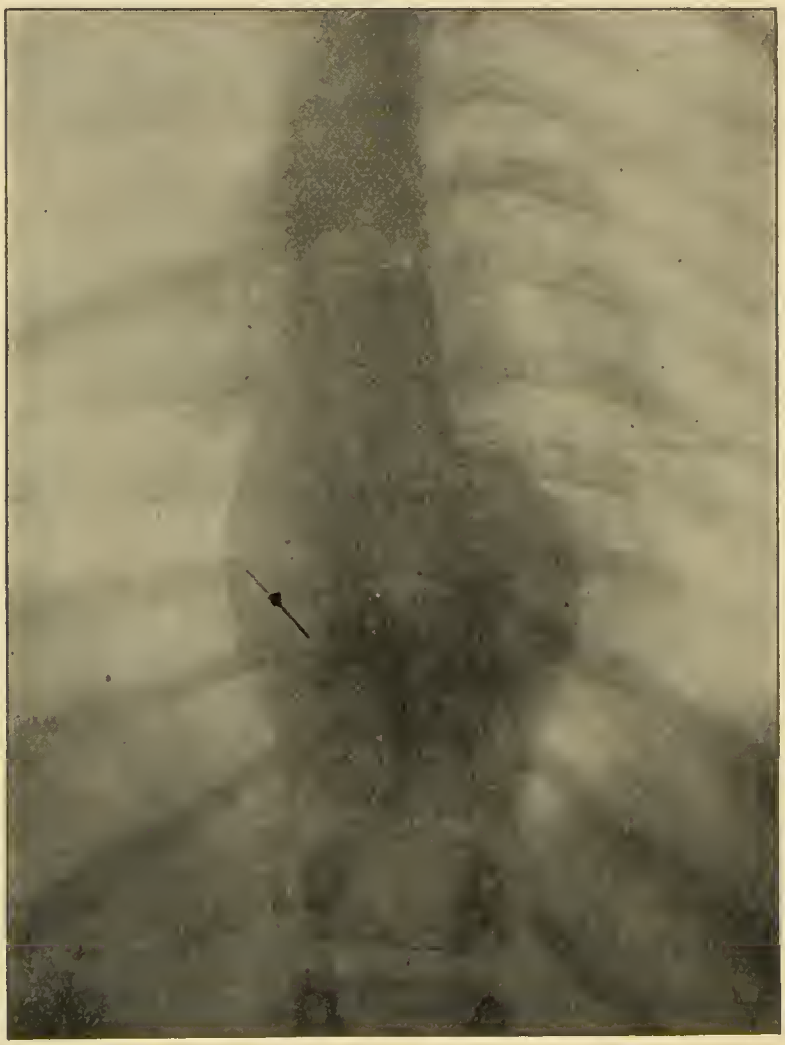

FIG. 95.—Shows an abscess; also deviation of the spine.

The abscess may extend into the neck laterally without forming a retropharyngeal abscess, or it may extend so secondarily. It appears at the posterior margin of the sterno-mastoid usually, although at times it burrows into the anterior triangle.

A retropharyngeal abscess may—

(1) Burst into the pharynx, after which if left alone and care be taken to keep the pharynx clean cure *may* result. On the contrary, the cavity usually becomes septic and an acute inflammatory condition arises which may be fatal.

(2) It may track downwards along the fasciæ into the mediastinum,

(3) Or laterally into the neck.

(4) When low down it has been known to burrow into the axilla along the big vessels and nerves, guided thereto by the fasciæ.

An abscess situated in the *dorsal region*—

(1) May become and remain mediastinal until secondarily infected, or become a residual abscess by absorption of fluid and calcareous deposition.

(2) Or it may burst into the lungs or œsophagus.

(3) Occasionally it tracks upwards into the posterior triangle of the neck.

(4) The most favourable and usual behaviour is when it follows the course of the INTERCOSTAL nerves as stated on p. 394, where the site of dorsal abscesses has been referred to already. After tracking along the ribs it may infect them at some portion of its course, and is then often associated with an *empyema*.

(5) Or again when situated low down it may track downwards under the internal arcuate ligament and enter the psoas sheath.

An abscess affecting the *lumbar* region invariably becomes a psoas abscess, although it may not track far down but extend backwards (see p. 396) and appear as a *lumbar abscess*, usually pointing in Petit's triangle, where it may simulate a hernia (as the abscess also has an impulse on coughing), or a fatty tumour.

A *psoas abscess* is the tuberculous process when it has invaded beneath the sheath of the psoas; it may destroy a large amount of the muscle or it may damage it superficially and pass down between the muscle and the sheath.

When it reaches the ilio-psoas junction at the brim of the true pelvis it generally fills the iliac fossa and may either escape above the iliac crest, which it rarely does, or pass down over the brim of the true pelvis and escape through the sacro-sciatic notch into the gluteal region or down into the pelvis and burst as an ischio-rectal abscess, or through the bladder or rectum.

Following the ilio-psoas tendon the abscess generally passes under Poupart's ligament, then beneath the femoral vessels and points inside the line of the vessels.

Under Poupart's it becomes constricted, but in the loose tissue of Scarpa's triangle may again expand to a large size.

It may sidetrack along any of the branches of the profunda artery and appear behind the great trochanter or in other parts of the thigh.

The caseation which leads to abscess formation is not usually attended with much constitutional disturbance, and as psoas abscess is but a continuation of an abscess already formed it may become quite extensive before its presence is suspected or detected.

Abdominal discomfort, referred pains along the parietal nerves, increased evidence of toxic poisoning as evidenced by greater malaise, &c., pain or difficulty in using one thigh.

A tendency to flex the hip and bend to the affected side, and a new series of referred pains down the gluteal or crural regions usually appear.

To *examine* for psoas abscess the patient should be laid flat on his back, the hip on the affected side flexed to relax the abdominal muscles, then the fingers can palpate the deeper portions of the abdomen outside the rectus muscle; deep elastic resistance occurs over the abscess, there is also tenderness in the course of the psoas and spasm of the abdominal muscles, so that a hand placed on the loin is not permitted to grasp deeply as one does when palpating the kidney.

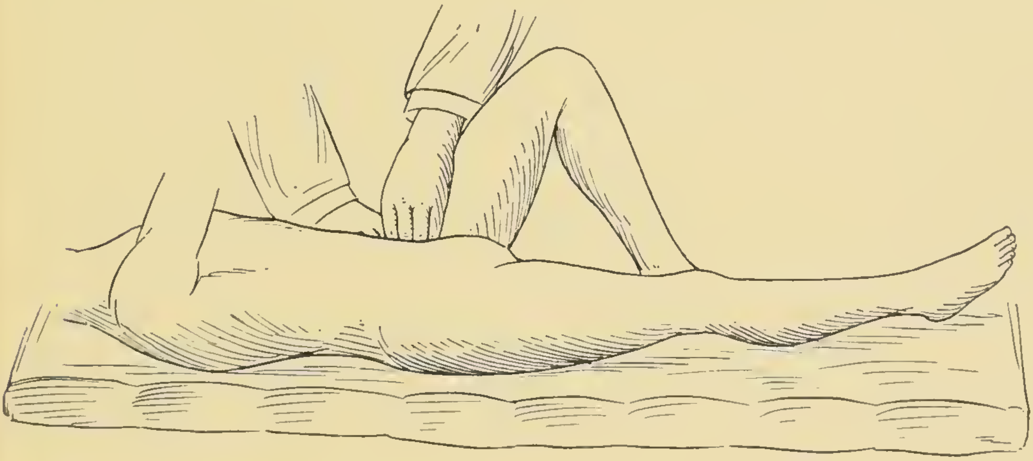

FIG. 96.—Examining for psoas abscess. As in all abdominal palpation the fingers of one hand are superimposed on the fingers of the other hand.

When the abscess is large its fluid nature can be determined and when it has extended below Poupart's ligament fluctuation transmitted below and above this structure is felt. There is an impulse in the groin on coughing, but no gurgling, the groin swelling cannot be reduced without increasingly distending the loin and it has not the feel of intestine or omentum.

The increasing tension of a large abscess leads to more marked local symptoms, and when it comes to the surface and points the skin reddens, becomes tender and hot, and some degree of infection of the abscess cavity by micrococci takes place.

Paraplegia may be due to two distinct causes.

(1) To an inflammatory affection of the meninges and peri-meningeal structures, *i.e.*, *pachymeningitis* leading to toxic or vascular and reflex disturbances in the cord; or to the further extension of the inflammation into the actual cord, a *meningo-myelitis.* This is usually a chronic sclerosing type, but an acute myelitis is occasionally seen, while a hæmorrhage may at times bring on acute symptoms.

(2) To actual *compression* of the cord. (*a*) This is very rarely due to compression of the cord by actual bone as a result of the acuteness of the angular deformity; an actual pathological dislocation or fracture of the vertebra or sequestra may produce compression.

(*b*) It is generally due to caseous or fibroid masses of tubercular granulation tissue involving the posterior common ligament and meninges, producing compression of the cord against the neural arches.

(*c*) The extension backwards of an abscess may result in pressure of a severe type.

Paraplegia generally results from *dorsal* caries; authorities differ as to the site, the eighth dorsal or cervico-dorsal are the two common places associated with it.

In the *lumbar* region compression of the *cord* is impossible below the first, as it has there split up into the cauda-equina; *nerve-root* symptoms may arise.

In the *cervical region* the spinal canal is sufficiently capacious to accommodate a large amount of extraneous material before compression occurs.

The onset of this condition takes place in about the third year of neglected cases, but it may be earlier. It develops in about 7 per cent.

Symptoms and Signs.—These vary considerably in degree, but one of the characteristics of this form of myelitis is the early *picking out of the motor areas* and the *comparative escape of the sensory tracks.*

Thus *gradual loss of motor power* first evidenced by dragging the toes and sense of weakness in the legs (paresis), with increased reflexes, exaggerated knee jerks and ankle clonus.

Then follows complete *paralysis* with rigidity from contracture of muscles, then atrophy. By this time loss of sensation supervenes and bed sores are liable to form, which become very septic and may lead to septic meningitis or septicæmia. A zone of paræsthesia or anæsthesia may exist at the section compressed. A form of traumatic arthritis is commonly produced in cases of spinal cord disease resulting in contractures.

If the *lumbar enlargement* is involved as a terminal phase in any paraplegia there may be weakness of the sphincters with either dribbling of urine or periodical involuntary evacuations.

When there is actual compression the cord becomes constricted and attenuated, while microscopically fibrosis is observed.

The general health in the milder and earlier cases is but little affected.

The *prognosis* of paraplegia is good ; the duration of the condition may be three or more years, oftenest about one year.

Recurrences take place, and periods of prolonged inactivity, followed by recovery or rapid degeneration, occur.

If *sensation and motion* are *both* seriously affected incomplete recovery is the rule; a spastic condition of the adductors not infrequently remains, resulting in cross-legged progression.

The symptoms must not be confounded with those of the severe nerve-root pains, which occur as a result of tuberculous neuritis, or from compression of the nerves by displaced vertebræ and ribs, which produce either a *local* motor or sensory disturbance.

The **diagnosis** depends upon careful examination, and will generally be made, even at an early stage, if sufficiently careful investigation is made.

Painful scoliosis, rheumatism, intercostal neuralgia on the one hand, and severe lesions of the spine and cord on the other, have to be excluded, for example—

> *Primary or secondary carcinoma and sarcoma, pressure from tumours and aneurysm; syphilis which produces typical caries. Hydatids also occur and septic osteomyelitis of the spine.*

But (1) Hip-joint disease
(2) Sacro-iliac ,,
(3) Infantile paralysis
} are the most difficult to differentiate.

Finally, but primarily in time, X-ray examination reveals the state of affairs. From time to time the examination must be repeated, as thereby the progress is observed, and if abscess formation is taking place it can be diagnosed early.

The ABSCESSES may be simulated—

(1) *In the cervical region* by :—
Bezold's mastoid abscess.
Suppurative lymphadenitis.
Wry-neck from other causes.

(2) *In the dorsal region*—

Empyema and chronic pleurisy.
Caries of rib.
Malignant growths and abscess of the mediastinum.

(3) *In the lumbar region* :—

Suppurating lumbar lymphatic glands.
Peri-nephritic abscess.
Other forms of iliac abscess
  Cellulitis.
  Osteo-myelitis of the ilium.
  Suppurating hæmatoma.
Peri-colic and pericæcal abscess.
Hip disease with abscess.
Sacro-iliac disease with abscess.

In the groin :—

Femoral and inguinal hernia.
Fatty and cystic tumours.
Aneurysm of the iliac artery as well as hip abscess and suppurating glands.

The differential diagnosis of :—

	DORSI-LUMBAR CARIES	SACRO-ILIAC DISEASE	HIP DISEASE
Age of patient...	Childhood ...	Young adults...	Childhood
Pain	Usually girdle and referred pains marked	Over sacro-iliac joint, only mild referred pains	In the hip or antero-internal part of knee
Tenderness ...	On pressure over transverse processes	Over sacro-iliac joint	Over great trochanter or Scarpa's triangle

	DORSI-LUMBAR CARIES	SACRO-ILIAC DISEASE	HIP DISEASE
Limitation of movement	Marked in spine, especially to rotation. Hip freely movable and painless	Free movement of hip if pelvis steadied. free and painless	Hip movements, especially tailor's posture, limited, also painful
Spasm and atrophy of muscles	Erector-spinæ prominent both sides. Buttocks equal	Usually in early stage unobserved	Early loss of gluteal fold, atrophy thigh muscles
Attitude	Special posture. Usually the lower limbs symmetrical and equal	Some apparent lengthening of lower limb. Buttock projected laterally	Flexion, abduction and eversion; first, apparent lengthening; later, inversion and shortening
Deformity ...	Median angular curvature	Nil in spine. Swelling or fulness over joint	Thickening and induration about great trochanter
Effects of pressure	Pressure on trans. process very painful	Pain over the joint	Pressure on trochanter may be painful
	Pressure on both sides of pelvis = Nil	Pain in sacro-iliac region	Nil
Abscess ...	If local in back the situation points to spine. If a sinus exists, a probe may be passed to lumbar vertebræ	Swelling over or sinuses lead to the joint region	Sinuses may be traced to the joint. Often they are too tortuous. When numerous in the thigh, generally indicate hip joint disease

The differential diagnosis in general must be made—

(1) By close inquiry into the previous health, and ascertaining the fact of whether certain organs or systems have been affected previously.

(2) The mode of onset of the symptoms.

(3) The presence or absence of associated symptoms due to affections of other structures.

(4) By careful examination.

(5) The use of X-ray and other tests.

It is impossible to give any real concise help in the differential diagnosis, it entails a careful elimination of other lesions. The greatest difficulty will be to convince oneself of the absence of tuberculosis in the hysterical and mild traumatic neurasthenias.

The *prognosis* of tuberculosis of the spine in general is good, its course has been indicated in the pathology and clinical symptoms.

The *prognosis* as regards recovery depends—

(1) Upon early diagnosis.

(2) *And in this, as in all forms of tuberculosis, especially upon the presence or absence of a healthy digestive tract.*

(3) Upon the site of the abscess. If this ruptures externally and is amenable to treatment, and DOES NOT become septic, the outlook is favourable.

(4) If it become septic, the fever and drain upon the patient's vitality is great, and asthenia to a severe degree results.

(5) A considerable number of abscesses burst internally and with fatal results, while ulceration into large vessels with severe hæmorrhage has occurred.

(6) Diseases of the upper cervical vertebræ have the additional danger of sudden death from compression of the medulla and cord.

(7) When the cord is involved, and the bladder requires catheterisation, unless the instrument *and the lubricant* are both boiled and contamination by the fingers avoided, septic cystitis is almost certain to follow. Cystitis of this kind is always *manufactured.* Bed-sores also increase the gravity of the case.

(8) It is more favourable in childhood than in adult life.

In regard to life expectation (Neidert) :—

(1) Persons with slight deformity have as good a life as normal individuals.

(2) Persons with medium deformity die young of phthisis.

(3) Persons with severe deformity die of heart failure or fatigue.

Treatment.

This is divided into local and general.

The local treatment here, as in all joint cases, aims at
relaxing the muscular spasm,
removing the superincumbent weight,
providing rest to the inflamed part,
preventing or correcting deformity,
to meet the complications.

All these indications may be met in two ways—
(1) by putting the patient to bed,
(2) by effecting some degree of extension.

During the early and acute stages there can be no doubt that absolute rest in bed is *the* mode of treatment.

At the present time there is an increasing tendency to put the spine in a state of hyper-extension (*i.e.*, dorsi-flexion) both before the onset of angular curvature and subsequently; some degree of pressure over the prominent spines is also advocated. This will be referred to again.

The *nursing* of a spinal caries case in an ordinary bed requires a special arrangement of the mattress, something of the nature described in Cheyne and Burghard's "Surgery," part iii., p. 26:—

The *mattress*, made of horsehair, is divided into three transverse segments; the central segment is subdivided into two lateral halves. This segment must be as narrow as will just conveniently admit a bedpan or some modification thereof.

Or a circular segment may be removed from the position of the nates and the excreta passed into a vessel placed below this orifice.

Both methods present some difficulties in actual use, and in dorsi-lumbar caries to be really practical it is necessary for the child to wear a double Thomas's hip-splint to EFFECTIVELY support the back while the bedpan is used, and other necessary manipulations performed; otherwise great care must be exercised in supporting the body when the section of mattress is removed to slip in the bedpan.

The *bed* should consist of a strong spring frame made rigid by fracture boards, which prevent unequal movements of the mattress and the consequent rolling of the body.

The head is kept as low as possible and the body and head steadied by sandbags, which also fix the roller towel passed across the body and thighs.

If there is already deformity undue pressure on the angular projection is prevented by placing pads of flannel wool or felt on either side of the spine over the erector-spinæ and its prolongations above and below the diseased area.

Some authors advocate pressure on the angular projection; this must be very carefully graduated and pressure-sore guarded against; but I do not advocate its use except as a part of treatment by hyper-extension (see later).

There is no real advantage in a *prone* position, unless bed-sores or other positive indication exists.

Extension and Counter-extension.—In the case of the upper cervical region a head extension is an absolute essential, also some form of lateral support to prevent rolling of the head; the most perfect fixation is necessary.

When the disease affects the dorsal and lower cervical area it is wise in the early part of the treatment to apply head extension, and while the weight of 2 or 3 lb. is sufficiently counteracted by the body-weight and towel fixation, I think it wiser to apply a thigh extension by the usual strapping method in all cases.

The legs are placed somewhat abducted.

Two to 4 lb. to each limb is sufficient unless the patients are muscular or adults, when it may be necessary to exceed this at first, subsequently returning to the smallest effective weight.

Patients *will* somehow slip towards an unopposed extension.

Mechanical fixation is effected by jackets made of—

(*a*) Fixed plaster-of-Paris	These are also now made hinged so as to be removable for washing purposes.
,, silicate of soda	

poroplastic felt
leather
wire-wove splinting
paper
bamboo
wood.

(*b*) *Spinal braces of various forms*, the American modifications being excellent, rendering this an ideal form of fixation and permitting early ambulatory treatment.

(*c*) Thomas's splints; Phelps's box; spinal beds of complicated structure.

In order to permit the patient to be wheeled about, a special bed-frame capable of being placed on a carriage may be constructed; or, when the spinal condition is improved, a light iron frame (gas pipe) with a stout canvas stretched tightly across and laced to it may be insinuated under the patient, who is then fixed to the frame by webbing and buckles, and carried to the wheel-chair or placed in the open air.

When the disease affects the lower dorsal and lumbar region a *double Thomas's hip splint*, with a broad pelvic band and the vertical rods along the back specially widened to support the angles of the ribs, and having a neck-piece extension to fix the head and neck, makes a most satisfactory apparatus (see fig. 70).

It is cheap, permits of thorough cleanliness, is as portable as a Phelps's box, over which it has several advantages, and is really effective. If hyper-extension of the spine is desired the splint is easily moulded into shape.

Experience has shown that the ordinary jury-mast, *i.e., straps*, passed under the chin and occiput and slung to an iron arch extending above the head, is far inferior to a rigid collar supporting the occiput and chin, such as is easily fixed to the double Thomas's splint, and is the type meant when a headpiece is mentioned.

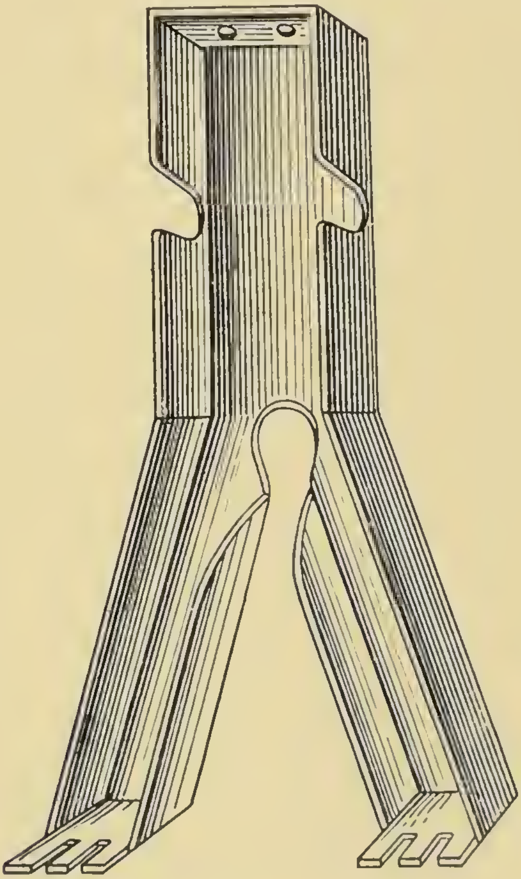

FIG. 97.—Phelps's box.

For hospital patients it is an exceedingly valuable mode of treatment; extension, fixation, portability, all are well provided for.

Although many surgeons use plaster-of-Paris in these cases, I think its disadvantages far outweigh its advantages, and even in the case of the poorest patients it is not finally satisfactory.

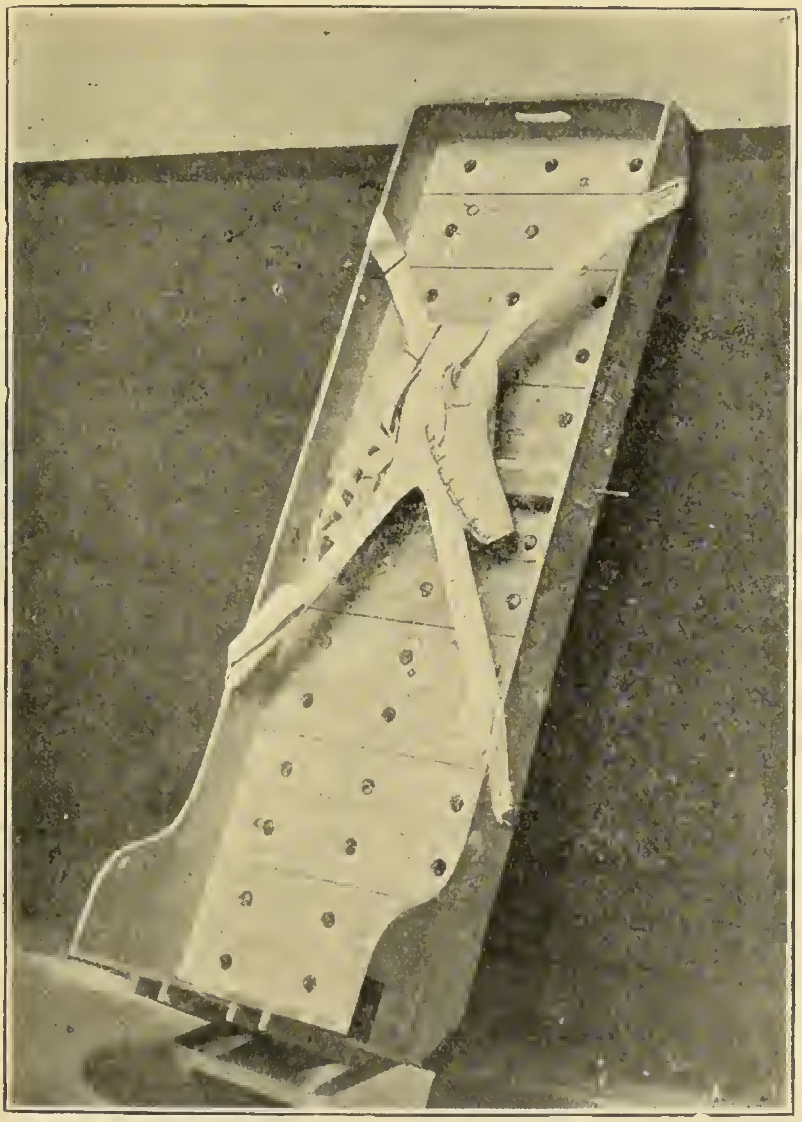

FIG. 98.—Dr. Gauvain's modification of the spinal board used at l'Hôpital Maritime, Berck-sur-mer. The jacket and webbing used to fix the patient is shown, also the wooden cross-piece by which hyper-extension is secured.

Perhaps the most perfect method of fixation, and one which provides extension and counter-extension, is that by Phelps's box, or the special modification designed and used at the Alton Cripples' Home by Dr. H. J. Gauvain (see figs. 98, 99, 102).

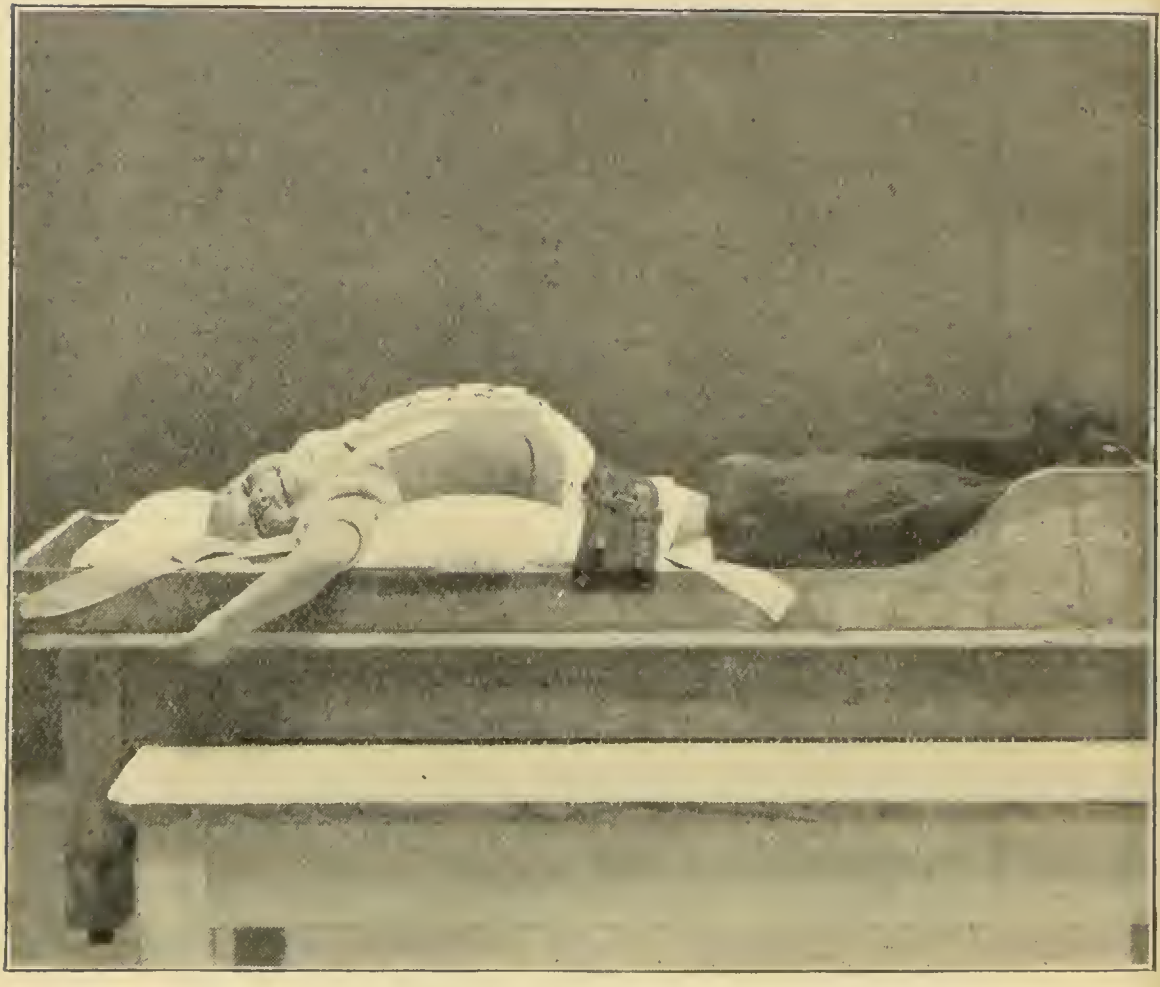

FIG. 99.—The patient fitted with the special jacket is fixed to the board shown above, and lies on a horse-hair mattress two inches in thickness. Underneath the situation of the angular curvature the wooden cross-piece (see above) is placed, so securing hyper-extension of the spine. Head and leg extension is applied in the usual way, if desired.

Fig. 97 indicates Phelps's apparatus; it should be at least 15 to 18 in. longer than the patient, and wide enough to permit of good thick padding. The sacral aperture should be larger than is indicated, as soiling easily takes place. The depth of the sides for a child is about 6 in., and in proportion to older cases.

The head extension is made by occiput and chin straps attached to a broad elastic band or tubing, passed through a slit or holes in the head-board, to which it is fastened.

The leg extension is applied by strapping to the leg and thigh, and either an elastic band or a spring forms the actual extending force. The legs and thighs are also firmly bandaged to the apparatus, after the extension is applied. The forearms are slung on canvas stretched across the frame in a suitable position.

When the patient is improving and in a fit condition to undergo ambulatory treatment, *i.e.*, to walk, by far the best mode of taking off the superincumbent weight is by means of an *orthopædic spinal brace*, with a neckpiece to support the chin and occiput.

The principle consists in forming a firm pelvic support by a metal band; from this is carried two vertical metal uprights, one on either side of the spine, to support the *transverse* processes, not the spinous process; these correspond to the normal contour of the spine, or the nearest available to it when the patient lies prone or is suspended. The upper extremities of these uprights support crutches or armpieces, which take the weight of the shoulders.

Lateral arms or pad-plates are fixed at various levels to exercise gentle pressure upon the angles of the ribs.

Various straps and buckles fix the apparatus to a chestpiece of felt, leather, or other soft substance.

The back pieces are either prolonged upwards or carry a prolongation bearing the occiput and chin rests, to take the weight of the head and neck.

The American braces have been much elaborated to meet the necessities of spinal cases; Goldthwait's modification of Taylor's brace is a simple and effective machine. Ernst's brace here figured is equally good.

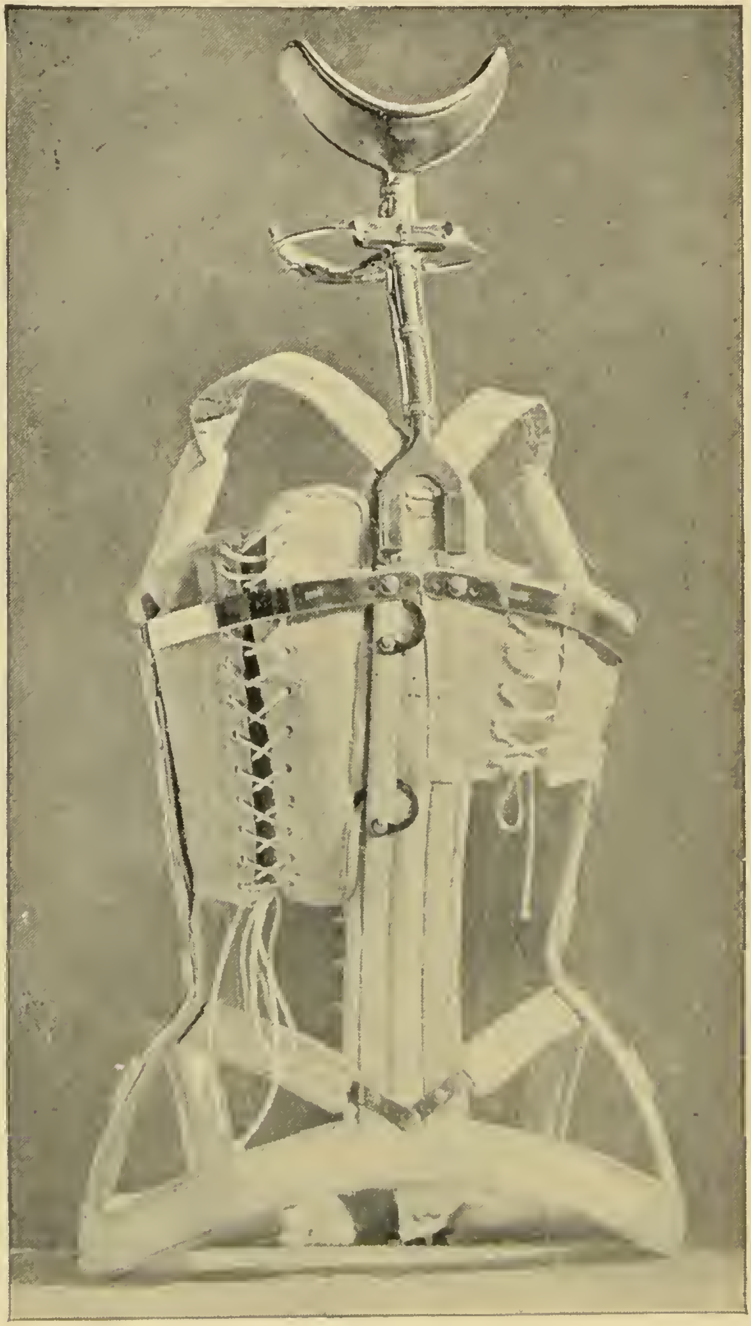

FIG. 100.—Ernst's spinal brace with occipital and chin supports for head extension (see text).

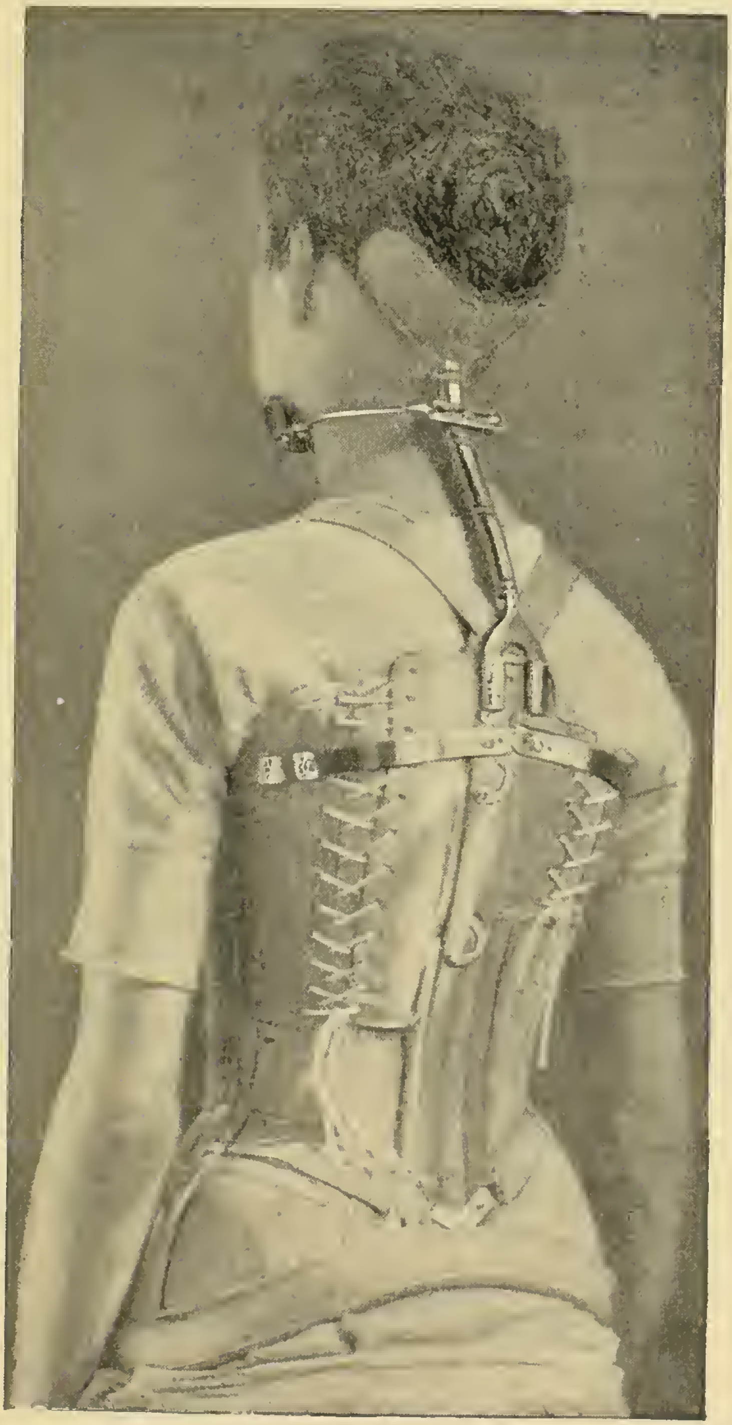

FIG. 101.—A patient fitted with Ernst's spinal brace or jacket.

There can be no doubt that the neckpiece should be used in *all* spinal cases when the patient first begins to get about, later the headpiece can be discarded.

For *caries* of the occipito-atlantal and atlanto-axial joints absolute rest in bed with an extension and lateral support by sandbags *is the only safe method of treatment.* It should be continued for at least six months, and probably twelve months will be required in many cases, before even attempting ambulatory methods other than that provided by Phelps's box or a portable bed.

Great care is necessary in providing against bed or pressure sores; a considerable amount of attention is entailed in nursing these cases, and the patient should be frequently washed, &c.

If the patient simply lies on the bed, the body must be rolled over most gently to get at the back; the pelvis, shoulders and head must be turned together and the spine supported while this is done.

If a Phelps's box is used the whole arrangement, patient and box, is placed face downwards and the fixative bandages and extensions freed; the box is then *raised off* the patient, who remains prone.

When the washing, &c., is finished the box is lowered on to the patient, the extension, &c., re-applied, and then the box and patient turned right side up and the front of the patient washed.

The same applies to a double Thomas's splint.

If the surgeon is placed entirely on his own resources a Phelps's box can be made of plaster-of-Paris. The patient is placed prone on a couch, which is protected by sheets of paper, with a stockinette undervest and long stockings on, *i.e.*, the leg pieces of pants; the arms are abducted clear of the body, while the legs are abducted to about 30 degrees.

The sides of the head and neck are built up by sandbags and a towel placed over them, and the lateral aspects of the trunk are padded uniformly so that a loose fit may result. When the plaster-of-Paris is poured over the body, a box roughly of the shape of a Phelps's box results.

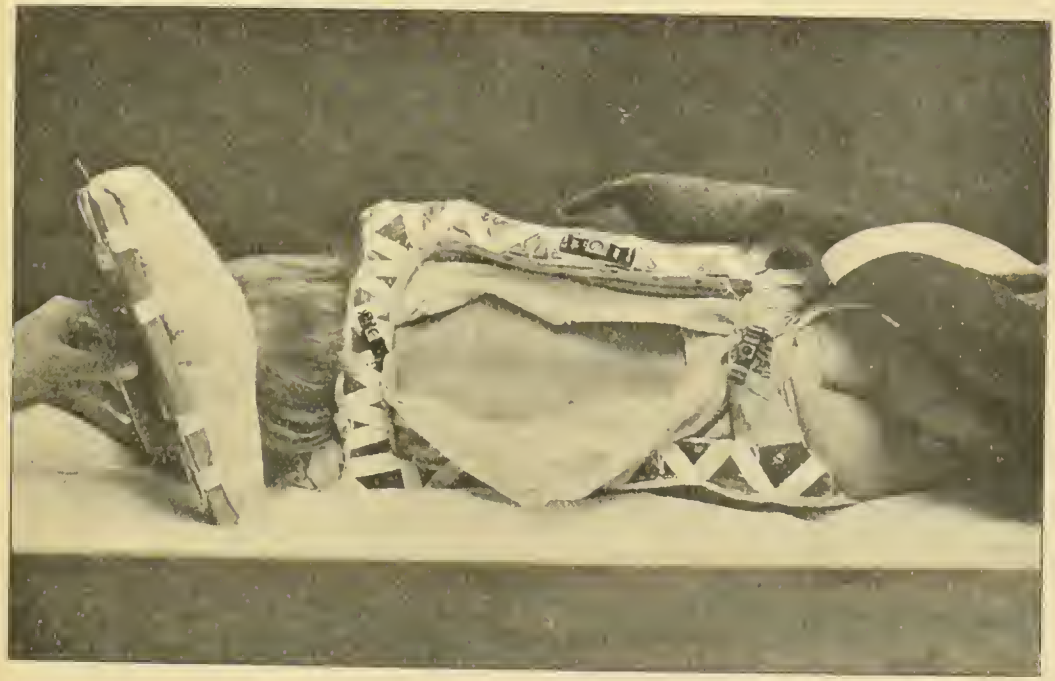

FIG. 102.—Dr. Gauvain's spinal splint made of soft wood, and completed by a webbing jacket. The "back door" is shown removed, standing on end, exposing the back of the patient for inspection and nursing purposes. The splint is padded with animal wool; it is easily made and cheap.

The plaster edges are trimmed and rounded, and it may be lined with leather and have webbing or straps fixed on for extension, &c.

In the same way a wire-wove splint, *i.e.*, small meshed wire netting, can be fitted to the trunk with a silicate of soda dressing for stiffening.

Taken all in all a double Thomas's hip splint with head extension is the simplest effective apparatus.

Chafing and pressure must be carefully guarded against, and cleanliness scrupulously maintained.

ABSCESS FORMATION.—When this exists in an inaccessible part nothing active should be attempted, but greater care and absolute rest with good nutritious diet, general hygiene and everything that can possibly increase the patient's resistance and recuperative power should be carried out to its fullest extent.

I again repeat that from ℥i to ℥iii of raw meat juice should be given in addition to plenty of meat, milk and eggs in the dietary.

Tuberculin.—The whole question of vaccine therapy is so indefinite, the results so variable, not only in the hands of the same clinician but under similar conditions in different cases, also that these spinal cases naturally tend to improve, and any special methods of treatment adopted obtain the credit for results when time and nature would and do in similar circumstances effect the cure.

Therefore if a case is not progressing under the above treatment, vaccination by tuberculin may be very cautiously tried.

When the abscess has become accessible it should be treated in the manner now adopted in tuberculous abscesses in general.

(1) By aspiration, or trocar and cannula.

(2) By incision, evacuation, and immediate suture.

(3) Either, with iodoform-glycerine.

The precautions to be followed are given fully on page 456.

Personally I think it a mistake, not only in tuberculous cases but even in pyogenic cases, to curette or sharp spoon away *all* granulation tissues. Swabbing firmly will remove all dead or dying surface tissue, and the tension in the abscess once relieved, the micro-organisms die, the younger granulation tissue becomes healthy, and serves a most useful purpose, hastening recovery. Furthermore the filling of an abscess cavity by extravasated blood is encouraged by the sharp spoon and excessive manipulation, which is most undesirable.

In *dorsal or lumbar* abscess aspiration and the introduction of iodoform-glycerine to the amount of one-sixth to one-fourth the pus removed should be carried out. Larger quantities may be used with safety, and indeed it is wise to inject a considerable amount, maintain firm pressure over the sac (and orifice of the cannula, if such is being used, by means of a sterile swab, not the finger, unless it is gloved) for ten minutes, to permit of the iodoform permeating into the granulation tissue, then allow the excess of emulsion to return, arranging that one-sixth to one-fourth remains in the sac.

Strict attention to asepsis is imperative. I never now seal the orifices with collodion, but put on a dry dressing.

Cervical abscess, if prominent in the pharynx, should NOT be opened there unless impending asphyxia demand such urgent treatment. Aspiration is then the proper course to pursue, but if it is opened the head should be hyper-extended and placed below the level of the thorax, so that none of the pus is aspirated into the trachea or swallowed.

Food should be withheld for forty-eight hours, and rectal feeding resorted to, and constant swabbing of pharynx with weak (5 vol. per cent.) hydrogen peroxide carried out.

But even when this is done and the danger of œdema of the glottis is over it will probably be wiser to do tracheotomy to enable the pharynx to be lightly packed with sterile gauze, and thus hasten recovery and healing of the pharyngeal wound, as the danger of septic infection reaching the abscess cavity and directly extending to the spine is very great.

So that it is generally wiser and safer to perform tracheotomy or laryngotomy and at once proceed to open the abscess *in the neck*, or if the child has been unable to swallow food and been cyanosed and partly asphyxiated for some days, the abscess may be left for twenty-four or forty-eight hours *after the tracheotomy*, and then the operation through the posterior triangle carried out. The earlier steps of this operation are done by dissection, but the actual opening of the abscess behind the pharynx is done by Hilton's method, *i.e.*, inserting a *closed* forceps and withdrawing it with opened blades.

When the abscess is low down in the neck an operation offers very serious dangers and difficulties, and it may even be wiser to wait and hope for pointing in some accessible spot.

Psoas Abscess.—When small and difficult of access —*i.e.*, needing definite laparotomy—it is wiser to wait until it has increased in size.

Otherwise a lumbar incision at the external border of the erector-spinæ and separation of the quadratus will afford access to the abscess when this lies moderately low down.

Under the fluorescent screen one *could* puncture the abscess from the loin posteriorly, bearing in mind the anatomy of the part, aspirate its contents, and inject iodoform glycerine.

When the abscess involves the iliacus muscle, and lies *in contact with* the anterior abdominal wall, it can be punctured and evacuated by means of a trocar and cannula, or a large aspirating needle.

If it is *not* in contact with the anterior abdominal wall, but is of large size, it is usually wiser to make a small intra-muscular incision, and expose the sac or iliac sheath, and then to puncture and empty it, or to incise it freely, and then close the cavity by a purse string or mattress suture of finest catgut.

Every precaution against contamination of the abdominal cavity must be taken.

Even when not actually in contact with the anterior parietes, a puncture can usually be safely made if an absolutely dull spot is selected, or a moderate amount of gas passed into the colon to distend and outline it, and a spot *outside* this selected for the puncture.

The cannula should be a fairly long one, and should be passed into the sac to its utmost extent *once the fluid begins to flow*, as it is possible for the sac to collapse and retract off the end of the cannula. This may permit of intra-peritoneal contamination, or preclude injection of iodoform-glycerine.

The usual site selected for puncture or incision is just internal to the anterior superior iliac spine.

The skin is always incised when a puncture is made, as danger lies solely in infection from the skin; it should be closed by a suture after the operation is completed, but not sealed by collodion.

It is always wise to inject iodoform-glycerine; any quantity may be used without fear of toxic poisoning; but if too large a quantity is used, the granulation tissue may transude so large an amount of serum, or break down so rapidly that the sac may refil very quickly, and even leak through the puncture track.

Psoas abscess is the ideal cavity to use iodoform-glycerine in, as the intestine distends and causes uniform pressure on the sac, also if mild extension be applied to the thigh the sides of the abscess cavity tend to approximate and obliterate, and a smaller amount of the fluid may be used than in an abscess of equal size in any other part of the body.

Two to 4 oz., at least, should be used, and the patient should then have the buttocks raised, or the foot of the bed elevated, and a firm abdominal bandage applied from below upwards, so that the iodoform *may be directed towards the spine, and reach the carious bone.*

Re-aspiration is usually necessary, the time for which varies, however, and a second injection should be made. The character of the fluid aspirated determines future treatment in this direction.

If the abscess has passed into the thigh, it is wise to puncture there also *as soon as* the fluid begins to run from the iliac cannula, or this is stopped to keep the sac distended. If this is done, the sac may be washed through with sterile iodine, or permanganate of potash solution about ½ per cent., or normal saline; strong antiseptics should never be used.

If there is angular deformity, it should be prevented from getting worse, as can always be done by recumbent treatment and pads at the sides of the spine, otherwise *forcible* methods of correction should be avoided. Hyper-extension will help to correct the deformity and leave a more *vertical* ankylosed spine, but the curvature itself is of little moment, and may be ignored.

The PARAPLEGIA, which is generally associated with neglect, and especially in the relapsed cases of caries, must be treated on the general lines for spinal disease, *i.e.*, absolute rest in bed with head and thigh extension, which in some cases produces almost immediate improvement; and, in addition, prevention of bed sores and cystitis must be seen to.

The tuberculosis is generally of one to three years' standing, and the patients may be much debilitated.

Gauvain's[1] modified "board splint and jacket" seems to offer an excellent method of dealing with paraplegia, as does the double Thomas's hip-splint and Phelps's box.

When retention with overflow incontinence arises, catheterization with a Maw's aseptic gum elastic catheter, boiled and lubricated in a Herring's apparatus, is the most perfect and simple method, and will provide a perfectly sterile instrument.

If the meatus is carefully cleansed, and fingering of the catheter scrupulously avoided, the instrument may be passed aseptically to all practical purposes. The penis and glans should be carefully washed and dried after each catheterization.

The custom of constantly keeping a patient's penis in an urine bottle is not cleanly, even if the urine is not allowed to collect in it for long periods.

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[1] See plates reproduced by kind permission of Dr. Gauvain, from papers written by him, *British Medical Journal*, and *Lancet*.

The care of the vulva in females is equally necessary. Hexatetramethylene, urotropine, helmitol, of either 4 gr., should be given every three or four hours in a small quantity of water, or of acid. sod. phosph. ʒi. in the twenty-four hours.

It is important to effect evacuation of the bowel regularly, and to see that the nates are kept dry and clean and are frequently relieved of pressure; this can be done by suitable packing, by the use of air or water cushions of suitable shape and dimensions, or it may even be necessary and advisable to lay the patient prone for hours or days on end, especially if bed-sores are forming.

Friction with *spirituous solutions* is by far the best mode of keeping skin healthy if it is compressed for many hours. This should be done three or four times daily.

Powders, ointments, and lotions of all kinds are used, but watery solutions are better avoided.

Starch powder is the best powder to use; it may be mixed with well-powdered boric or salicylic acid.

Laminectomy is indicated only after prolonged treatment by rest and extension. The number of cases which need operation is small, and as the dangers of sepsis and in certain cases escape of excess of cerebrospinal fluid is great, the operation must be decided on only after careful consideration. The soft tissues and skin should be closed at once.

When the canal is opened the conditions must be carefully examined and dealt with according to the indications which they present.

For *caries in general*:—

The average duration of continuous treatment should be between two and three years.

Biggs states that for years after full growth has been attained the exact height should be taken once a year on the same date, at the same time, namely, immediately after rising in the morning, and also under the same conditions; that the arm of the machine should always touch the scalp in the parting of the hair, and any variation more than $\frac{1}{32}$ in. would be an indication to consider the resumption of a support.

This advice is repeated for what it is worth. I hardly think the amount of variation given is a rational one on account of the difficulty of deciding such a fraction of an inch.

Much as I value poroplastic for joint fixation, a poroplastic felt jacket is quite unsuitable for spinal caries. This also applies to leather. When any form of jacket is used it should take the form of the brace jacket, the principle of which has been already indicated.

THE CONSERVATIVE TREATMENT OF TUBERCULOSIS OF BONE AND JOINTS AND OF SUPERFICIAL ABSCESSES.[1]

THE knowledge that tuberculosis was (and is) due to a specific bacillus, which acted locally, and could therefore be attacked surgically, gave a great impetus to the operative treatment of tuberculous lesions of the extremities and superficial parts.

Previously, it was considered unwise, and therefore bad surgery, to open cold abscesses or to treat surgically other forms of tuberculosis, on account of the prolonged suppuration which resulted, and which was erroneously entirely attributed to the tuberculous process itself.

Then came the knowledge that the non-healing, and, indeed, often the increased virulence of the disease, when once attacked by the knife, was chiefly due to the contamination of the tuberculous area with pyogenic or putrefactive organisms.

The introduction of sound practical antiseptic, and, later, aseptic methods, generated the hope of exclusion of pyogenic infection and septic contamination, and gave birth to a school of surgeons who attacked local tuberculous disease in joints, glands, and elsewhere, on the principles of *radical* extirpation analogous to those guiding them in the extirpation of malignant disease, which can be cured only by thorough removal through healthy surrounding tissue.

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[1] Reprinted and slightly modified from the *Charing Cross Hospital Gazette*, May and June, 1903.

The expectations of this radical method, it is conceded by those best qualified to judge, and who have an open mind on the subject, have not been fulfilled.

While affording many striking instances of immediate relief, the ultimate results have been stultified by :—

(*a*) Recurrence of the disease.

(*b*) Deformity due to the removal of bone, or inequality of muscular action, or following upon inequality of length of limb, &c.

(*c*) Loss of function—complete or incomplete—the most frequent sequence of operative treatment on joints, however early adopted.

(*d*) A large proportion of deaths as the immediate result of the operation, especially on the hip.

(*e*) All the dangers and consequence of pyogenic infection. To these I will return later.

At any rate sufficient evidence is forthcoming to justify scepticism of the wisdom of extensive operation as the *set* method of treatment of tuberculous arthritis, teno-synovitis and abscess.

On the other hand, clinical and pathological experience has shown that not infrequently tuberculous processes have healed or subsided spontaneously with excellent functional results, proving that the body is capable under suitable conditions of successfully combating the progress and eventually destroying or rendering *hors de combat* the tuberculous process, if not the tubercle bacilli.

That such foci may be relit into activity under adverse conditions, does not stultify the fact nor weaken the argument.

Consequently arose a method of treatment, designated the *conservative* treatment of local tuberculosis. The votaries of this method of treatment, taking greater note of the *soil*, of natural and acquired immunity or antagonism, of the beneficial influence of rest and good hygienic and dietetic conditions, aimed at combating the disease by placing the subject under the best of circumstances, and by providing relief from pain and the *injurious* effect of function and muscular action by means of orthopædic appliances.

They considered, and experience has proved them right in many instances, that extensive tuberculous processes could be dominated by the tissues themselves, and that when such cure occurred the functional result was infinitely better than that following operation.

Between these two extremes there is a "moderate" school, who selecting the principles which are good in both systems have added to the conservative methods several new procedures, which add greatly to the efficacy of their treatment, and who employ such minor or atypical operations as they deem suitable.

It is from the moderate school, by a judicious selection of the cases, a combination of conservatism, aided where necessary by *minor* operation, by due consideration of the circumstances dependent on social and pecuniary status, by the age of the patient and the extent of the disease, whether complicated by fistulæ or by pronounced changes in the viscera, all of which are important factors demanding consideration in determining the exact mode of treatment, that the best results are to be looked for.

The measures adopted in the conservative treatment are :—

(1) The injection of iodoform in glycerine or other fluid vehicle.

(2) The production of venous retardation, "damming," in the diseased part, by bandaging in a suitable manner above the joint.

(3) The use of orthopædic apparatus.

Either of these methods alone, in suitable cases, gives excellent results, but in a great majority of cases they are best combined.

(4) The performance of minor or atypical operations in combination with the first three.

(5) The use of tuberculin.

The origin of the treatment by injections of iodoform in glycerine is based on the attempt to destroy the micro-organism *in situ*. The original attempts in this direction are interesting, but naturally were futile.

Koch used igni-puncture, in the form of Paquelin's cautery or the blowpipe.

Barker poured boiling water into the cavity, or raised water placed therein to boiling point by Paquelin's or other cautery.

Rabel employed caustics.

These three necessitated open operation.

Lannelongue based a "sclerogenic" treatment on pathological observation. He injected *about* the tuberculous focus solutions of zinc chloride, in the hope of forming a fibrous capsule.

Kolischer tried to hasten, by injections of solutions of lime, the deposit of calcareous salts.

Moleschott, as far back as 1888, highly extolled the virtues of iodoform, from experience, as strongly inhibiting tuberculous and septic processes, but the belief in its efficacy was founded on the erroneous impression that it was a germicide. This led to its employment in the conservative treatment of tuberculosis.

In considering the merits of any form of treatment one must look to :—

(1) The actual *method* of procedure, its applicability to the various stages of the disease and its situation ; its limitations. The mental effect associated with all surgical operations. And, not unimportant, the possibility of its utility in hands other than those of the specialist in surgery, *i.e.*, the general practitioner.

(2) The final, as well as the immediate *result*. This, the most important test, applies to the local condition in regard to retention or loss of *function*, more or less complete ; the *deformity* which may arise from loss of tissue, or interference with growth of bone in young subjects, or by *inequality of muscular action*, or, in the case of the lower limb, the deformity produced in the spine and pelvis by inequality in their length.

The *æsthetic* effect from the point of view of scars in the neck and elsewhere.

(3) The dangers.—In the case of both operative and conservative methods, the dangers of infection and sepsis enter, but in disproportionate degree. Death does follow, and not *infrequently*, as an immediate result of operation, while fatal cases of iodoform poisoning have been recorded, *but* in the early history of the treatment, as a result usually of defective knowledge of technique and dosage, occasionally associated with idiosyncrasy.

The possibility of producing miliary tuberculosis.

(4) The *duration* of the treatment—

As affecting length of stay in hospital.
,, ,, of after treatment.
,, the general health.
,, questions of economy in other respects.

Bearing on these points one considers the possibility of ambulatory treatment.

The relative merits of the various forms of conservative treatment will become manifest after a description of the details and when summing up the results. Suffice it to anticipate by stating here that on almost all points the conservative methods contrast with the operative most favourably, and in certain particulars, such as the important item of retention of function, the results, in suitable cases, are brilliant.

A brief, but necessarily incomplete, contrast of the orthodox operations practised by each school may not be amiss, as it must be clearly understood that by conservative one does not mean rigid exclusion of all operations, but that such minor or atypical operations as are deemed necessary are undertaken as an *accessory* to the other details of treatment. The personal predilection of the individual exercises considerable influence on the extent of the operations, some even going so far as to perform practically radical operations for abscesses, and fairly extensive operations on joints, and then, for security, adopting the iodoform glycerine injections; these latter practitioners come under the heading of the moderate school, but their *functional* results are no better than the radical school. But the majority of early cases can be successfully treated without cutting operations. The worse complicating factor, mitigating against the success of iodoform-glycerine treatment, is the presence of sinuses and fistulæ, which prevent, to a great extent, the application of one of the essential details, namely, the use of iodoform glycerine UNDER PRESSURE; but this is not insurmountable.

Radical Operations.	Conservative.
Abscesses. (1) Incision, thorough attempt to remove all lining membrane and infected tissue, immediate suture. (2) Ditto, with application of various strong antiseptics, followed by temporary drainage and suture. (3) Ditto, with packing of whole cavity so as to obtain healing from the bottom. (4) Excision of the whole abscess wall by removal through *healthy* tissue.	(1) Aspiration, puncture with trocar and canula, or puncture-incision with scalpel, in all cases through healthy skin. Removal of fluid contents. Injection of suitable dose of iodoform glycerine. Pressure. The *moderate school* employ incision and evacuation of contents of easily accessible disease, then fill with iodoform glycerine and suture closely. Pressure.
Teno-synovitis in all stages. Attempted removal of all diseased tissue by dissection. The use of cautery and caustics or chemical antiseptics.	*Teno-synovitis.* If degenerated into abscess treat as such. If in stage of pulpy granulation, puncture with needle of syringe, inject iodoform glycerine in various direc-

	tions through the one puncture (parenchymatous injections). Pressure.
Joints.	*Joints.*
(1) If very early: arthrectomy, *i.e.*, removal of all diseased synovial membrane. Suture. Result, invariably ankylosis or very restricted movement.	(1) If pulpy, puncture with needle of syringe, inject iodoform glycerine in various directions through the one puncture (parenchymatous). Pressure.
(2) If bone and cartilage diseased. Excision through healthy bone. Considerable loss of substance. Bony ankylosis.	(2) If abscess, treat as for abscess.
(3) If complicated with sinuses, these are extirpated or scraped.	(3) If in condition of hydrops, treat as for abscess, one injection, often effecting cure.
(4) Amputation.	
The *moderate school* use incisions instead of puncture, and more or less further removal of easily accessible tissue. They do not remove slices of bone, but gouge out diseased foci; they then employ iodoform glycerine and pressure. The functional result depends on amount of bone and cartilage removed.	The *conservative school* treat as for abscess, even if *bone*, as well as synovium, be diseased, *i.e.*, sequestra do not contra-indicate injections; on the contrary, these will either heal under treatment or rapidly be freed, and can then be removed (see p. 247).
	Combined with intra-articular injections of iodoform glycerine, injections

INTO the bone may be employed.

If sinuses exist, each is excised and sutured, and parenchymatous injections into their walls are used. If they cannot be sutured, they are closed by a plastic operation, one being left, through which iodoform glycerine is injected, and from which, by suture or by means of a pad of gauze, or other means, it is prevented from escaping; in this way all the sinuses may be filled with the mixture. Pressure is applied and repeated parenchymatous injections given. Functional results often surprisingly good.

How iodoform acts is problematical, bacteria flourish luxuriously in iodoform, it is not a germicide, but it is claimed that in contact with solvents it acts as a mild antiseptic, *i.e.*, antiputrefactive.

Hence its action when injected into tuberculous cavities is difficult to explain. By some it is thought that as iodine is set free in the disintegration which occurs, this acts as a mild germicide. Others claim that the free iodine diminishes the virulence of the tubercle bacilli and so permits of their destruction by the tissues. A third explanation is that the influence of the iodine is exercised on the *tissues*, modifying, in some way, *their* activity, so that they are enabled to cope with the tubercle bacilli and so destroy them.

The most probable explanation is that the mildly irritating properties of iodine bring about *hyperæmia* and *increased activity* in the tissues, with the result that the production of fibrous tissue is increased ; the vascular and cellular activity brings about more rapid destruction of the tuberculous process, so that destruction of the pathogenic process and repair by fibrous tissue formation go on together. As supporting this, König considers there is little or no difference in the result of treatment if carbolic be used instead of iodoform.

Recently bismuth paste has been used for the healing of non-tuberculous fistulæ, sinuses, &c., in the same way, *i.e.*, by injection.

That such repair occurs is proved by microscopical examination of the walls of abscesses, &c., after and before treatment. The tubercle systems, giant cells, and bacilli disappear ; in their place are large numbers of round and spindle cells, *i.e.*, young growing fibrous tissue, which at a later stage become typical fibrous tissue. The change in the character of the fluid contents which occurs soon after an infection is another evidence of the beneficial action of the iodoform, and is employed as a test of the progress made. (See later.)

The results of using iodoform as a dressing, by smearing or dusting over wounds, have been dubious, and its failure in the treatment of open tuberculous lesions and sinuses has cast great doubt upon its value, but there can be no doubt that when iodoform is employed for the treatment of *closed* tuberculous cavities, UNDER PRESSURE, its action is highly beneficial and curative.

The vehicle best adapted for its introduction into cavities is also the subject of much difference of opinion. Ether, olive and almond oil, mucilage acacia, alcohol, vasogen and glycerine, have all been employed, but a careful consideration of the facts, for and against, is greatly in favour of glycerine. The question of sterility of the mixture of iodoform and glycerine has caused great perturbation from theoretical objections: theoretical because if the mixture be allowed to stand, with occasional vigorous shaking, for some time, it becomes practically sterile, and no ill-effects from pyogenic infection have followed its use in a very large number of cases.

Glycerine is itself mildly antiseptic, but if required, 25 per cent. of alcohol, 1 per cent. of carbolic, or 20 per cent. of creosote may be added to the iodoform mixture. The iodoform may be steeped in 1 in 20 carbolic or 1 in 1,000 biniodide of mercury for some days or weeks and then added to the glycerine, but although there is no practical difficulty in sterilizing either of the ingredients alone or by heating when combined (under certain conditions), a sufficient number of careful observers verify that the mixture, if kept for a time, requires no further sterilization.

Two forms of treatment by injection are to be considered. The one into an abscess cavity, wherein by pressure the iodoform may be brought into contact with all parts of the wall at *one time*, and often effecting permanent cure after one injection. The second into and about the wall of sinuses, into masses of pulpy granulations and into and about bony foci; these injections are called *parenchymatous*, and need frequent renewal and injection in various directions, considerable difficulty being experienced in bringing the iodoform into contact with the whole of the diseased tissue.

The technique of iodoform-glycerine injection is extremely simple. The *apparatus* required for treatment by injection into abscess or other cavities consist of :—

(1) A sterilizable syringe of one or more ounces capacity, the nozzle of which fits accurately the cannula of a medium-sized trocar. The barrel carries two rings, or a bar, into which the index and middle fingers fit, so as to facilitate injection. These rings are not absolutely essential, but they will be found to add greatly to the ease of working.

(2) A trocar and cannula ; the trocar must be sharp and the cannula fit closely round its neck. Varying sizes may be used as long as a suitably arranged nozzle to fit each size is connected with the syringe ; for the majority of joints a medium-sized trocar best serves the purpose.

Aspiration is the most effective means of emptying an abscess cavity. The needle can be used for injecting the iodoform glycerine if it is made to take the nozzle of the syringe.

For interstitial or parenchymatous injections a smaller syringe holding about 3 or 4 drachms, with needles of larger calibre and longer than those supplied with the usual hypodermic syringe, and which *screw* on, is necessary. The needles now supplied for subcutaneous paraffin injections are of the proper calibre. The amount of force necessary to expel the contents is considerable, and so this syringe *must* bear two rings, or a bar, for the fingers. The stem must be graduated to ensure approximate dosage.

A few precautions are necessary :—

(1) Never inject through skin which is involved in the inflammatory process, or which is thin and likely to break down. Pass the needle or trocar obliquely through healthy tissues.

(2) Do not use cocaine or eucaine at the place of puncture ; both cause local damage—a real, not theoretical, damage—and entail an additional skin puncture, with its accompanying dangers ; use a ring anæsthesia, or the local injection into a vein devised by Bier, or even the ethyl chloride spray.

(3) In addition to boiling the syringe, trocar, cannula, &c., it is always wiser to puncture the skin with a scalpel. Infection of the cavity by pyogenic germs, and the skin with either tubercular or pyogenic germs, is thereby rendered more unlikely.

(4) Avoid the neighbourhood of vessels and nerves, puncture at a distance, and force the fluid into the dangerous area.

(5) In cleansing the skin, use the greatest gentleness, and do not vigorously rub off the superficial epithelium ; the employment of the spirit lotion—equal parts of soft soap and methylated spirit—applied on lint for a few hours, then gently scrubbed with methylated spirit on swabs, acts efficiently The use of 2 per cent. iodine in spr. vini. rect. or 90 per cent. alcohol gently rubbed into the skin may be safely relied on as a means of preparing the skin.

(6) Dress with a dry sterile gauze dressing and

endeavour at all times to apply firm pressure by bandage or strapping.

(7) Thoroughly shake the mixture. In filling the syringe, it must be remembered that iodoform deposits very readily in glycerine, and, while this has its advantage once it is in the tissues, yet its occurrence in the syringe must be avoided by rapidity of working.

The question of an *anæsthetic* has to be considered. Adults do not bear this puncture as well as they do that for hydrocele or aspiration of the chest, but, at most gas, or one of the newer anæsthetics (ethyl chloride group) is ample, or a regional local anæsthetic by injection into a vein or subcutaneous ring above the joint.

Pain is a variable and personal factor; an injection may in one patient produce pain lasting days, while another looks upon the operation as a temporary discomfort only.

The abscess or joint surface having been carefully prepared and incised, the trocar (or aspirator) is introduced and the fluid contents evacuated; the selected quantity of mixture is then introduced through the trocar, and the puncture sealed. A *large* quantity of dressing or cotton wool is placed over the part and a *firm* bandage applied (see p. 46).

The process, if necessary, is repeated in the course of some three to eight weeks; the character of the fluid withdrawn after one injection is that of a thick "*golden syrup*"; this change indicates a beneficial action of the iodoform.

Fixation.—The application of a splint in the case of the limbs is arbitrary, a matter of opinion. The upper limb may be merely slightly elevated on a pillow or kept in a sling and bound to the chest. *Rest* during reaction is most essential, so that when treating the lower limb the patient should, if possible, be confined to bed, with either a splint, sand-bags, or a *small weight* extension applied.

After the reaction has passed off the subsequent treatment, whether ambulatory or with the patient in bed, depends upon the local condition and the general health ; in general the ambulatory method is to be advocated, the patient wearing a simple orthopædic retentive apparatus, which is to be discontinued at the earliest suitable opportunity.

The parenchymatous or interstitial injections are made in the following manner. Suppose the case to be a joint in which the granulation tissue has not caseated and liquefied ; the syringe is filled with the iodoform-glycerine, the dose decided on, if small, is regulated by the screw nut on the piston, a suitable spot is selected through which the needle is passed into the deepest part, a few drops of the mixture are expressed, the pressure is maintained on the piston while the needle is *partially* withdrawn, so injecting the whole track. Then, the needle not having been withdrawn through the skin, it is passed into an adjacent area and the process repeated again and again until the dose of mixture is expended. If more than a syringe-full is employed the barrel is unscrewed from the needle and filled. Soon after the reaction subsides a further series of injections are made until the whole tuberculous tissue is impregnated with iodoform.

The intervals are usually about six to twelve days. Hitherto the quantities employed, from fear of evil consequences, have been too small. Ordinarily three to five injections suffice in moderate cases, but the number will depend upon the results obtained and the intricacy of the parts treated ; twelve or more have been necessary in some cases. If part of the tissue has broken down and formed an abscess, this must be treated early as such in combination with the parenchymatous injections (*vide ante*).

Tuberculous glands not yet broken down are treated by injections into and about the mass.

Sinuses and fistulæ are so often contaminated by pyogenic or septic organisms as to demand surgical treatment, such as vigorous treatment by Volkman's spoon, pure carbolic, zinc chloride, &c., but the best operative procedure is by free excision with or without immediate suture.

The use of the congestion method by suction or bandage is the best method of treating sinuses, but when situated about the hip or iliac fossa the bandage is not possible.

Should the *sinus*, however, be recent and not so contaminated, it may be treated in several ways :—

(*a*) Inject into it under pressure by means of a rubber tube and syringe, a quantity of the mixture, the escape of which is prevented by a dab of wool pressed over the orifice and maintained for ten to fifteen minutes, after which interval the dab is removed, a gauze dressing rapidly applied and kept in position by a broad piece of strapping or a bandage firmly applied. Pressure is most desirable. Special olive-headed nozzles are often used to inject sinuses. *Dressing.*—The frequency of redressing is determined by the amount of discharge existing before the injection ; if this be free then dress every two days, if slight, twice or once a week; on each occasion repeat the injection. Not infrequently two or three injections induce sound healing; in all cases, however, the diminution in the amount of the discharge is a marked feature.

(*b*) Employ interstitial injections into and about the wall of the track, entering the needle from sound healthy skin, never through the orifice of the sinus. Endeavour to minimize the amount of skin punctures. If there be carious bone at the bottom of the sinus this should, if possible, be surrounded and permeated with iodoform-glycerine, in which case methods *a* and *b* are best combined, or a trocar and cannula may be forced into the carious bone. In a short space of time necrotic portions of bone come away, or the whole process heals. The rapidity of separation of sequestra under the use of iodoform-glycerine is alone sufficient to justify its employment as a routine in sinus cases.

(*c*) If the sinuses are multiple, the best plan is to treat them by excision of the wall and immediate suture, leaving one with the sutures passed but untied, through which the mixture may be injected (method *a*), and, if deemed necessary, using also the interstitial injections (method *b*), but in very small quantities.

Dosage.—This is a matter of some importance and difficulty of precise decision, but cavities and tissues lined by granulation-tissue, which absorbs slowly, tolerate almost any quantity of the 10 per cent. iodoform-glycerine.

On the other hand, interstitial injections are made into more or less healthy tissue, from which absorption is rapid, and so the dose must be greatly diminished.

Likewise, if a sinus or cavity has been surgically denuded of its lining before injection, which, however, should not be done, the dose must be reduced. The age and sex of the patient regulate the dose in the usual manner.

The *maximum* quantity of iodoform-glycerine recommended for permanent cavity distension is :—

In adults, 3 to 4 oz.

In children, $\frac{1}{2}$ to 2 oz., according to age.

For parenchymatous or interstitial injections into tuberculous granulation tissue :—

In adults, 1 oz.

In children, 1 drm.

But larger doses may be used, and it is highly desirable to *distend* the abscess cavity with the mixture for ten minutes, to allow the iodoform to deposit, *then* to run off the excess, leaving in the cavity the dose previously decided on.

Always begin with small quantities, and note the resulting local and general reaction, which decreases with each injection.

If, instead of evacuating the cavity by trocar, it is decided to incise it, the quantity of mixture is introduced just before the suturing is completed, and then a firm bandage or strapping applied over the dressing.

The presence of *sequestra*, or caries deep in the tissues or at the bottom of an unopened abscess cavity, has been proved by results not to contra-indicate this form of treatment.

Although the whole bony mass cannot be saturated by iodoform-glycerine, even when perforated by a trocar and cannula, yet it obtains a fair share, and is surrounded by the mixture in the joint or cavity.

Like the wall of the latter, the specific granulations, and probably the bacilli, are destoyed, and the bone is treated by the tissues as an aseptic foreign body and the cavity heals.

As will be patent, after the method of treatment by congestion has been read, a sequestrum, even though at first inaccessible to the iodoform, may become accessible, when, as a result of the congestion, the granulation tissue binding it to the bone breaks down or a tuberculous abscess forms about it, the early evacuation of which leaves a route leading directly to the diseased bone, along which the mixture is forced.

The rendering accessible of such diseased foci is, indeed, in practice one of the great benefits of the "congestion" method of treatment.

Exuberant granulations may be treated in the usual way by the sharp spoon, &c., or by injecting 10 to 20 per cent. silver nitrate solution into the sinuses. If, however, firm pressure be applied, I have found that exuberance seldom occurs, and the method not infrequently used abroad of applying to the granulations a powder formed of equal parts of calomel and powered iodoform, care being taken to use only small quantities, acts exceedingly well. By the use of a suction glass the granulations rarely become exuberant.

If *abscess* in the head of a bone be suspected this may be punctured, its contents evacuated, and iodoform-glycerine injected.

Signs of local reaction following injection :—

(1) Increased swelling. This gradually subsides in three or four days, and in mild, favourable cases the disease completely disappears in the course of some weeks or months, leaving only a little cicatrical thickening.

(2) Pain, more or less acute, rarely persisting more than twenty-four or thirty-six hours. This occurs usually after parenchymatous injection, or with cavities enclosed by dense fibrous tissue.

If swelling and fluid be still present after, say, four weeks, puncture again, and if the fluid withdrawn is "golden syrup" it indicates that progress has been made; re-inject, but use a smaller quantity than the previous dose.

Cure is known to have occurred when swelling has disappeared, and only slight thickening remains, or the movements in joints and tendon sheaths are performed quite painlessly. The amount of movement depends upon the extent the pathological process had progressed.

General signs of reactions are practically those of fever. Rise of temperature rarely more than 3°; some headache; anorexia.

Points at which the injections may be made into various joints:—

Shoulder. (*a*) In front. Just at the outer side of the coracoid process.
(*b*) Behind. At junction of spine and acromion process of scapula.

Elbow. (*a*) Immediately above the head of the radius.
(*b*) On either side of the olecranon process.

Wrist. At tips of styloid processes of the ulna and radius.

Hip. (*a*) From the outer side. Place patient with limb in position of internal rotation, adduction and full extension, insert the needle immediately above great trochanter from the outside until it strikes the neck of the femur. It can then be further insinuated along this into the joint.

(*b*) From the front. With the limbs parallel, take a line joining the tip of great trochanter and point where the femoral artery crosses the pubic ramus, and where this line crosses the *inner* border of the sartorius, the needle must be thrust into the joint.

(*c*) From behind. Pass the needle forward and inward from immediately behind (at the back of) the great trochanter.

Knee. Insert the needle at either side of the patella, just below its centre. Also always inject the subcrureus bursa by puncture immediately above the patella.

Ankle. (*a*) On either side at tip of malleoli pass the needle at right angles to the malleoli, then, before striking the astragalus, direct the point upwards.

(*b*) At the sides of the tendo-Achillis behind, or the extensor tendons in front.

In addition to the foregoing points any swollen tissue may be injected, and in all cases the pathological tissue must be carefully and thoroughly injected.

Lumbar abscesses are most suitable for treatment by puncture and injection.

Psoas abscesses are best treated when the abscess wall is in contact with the abdominal parietes, the occurrence of which must be waited for. An incision can then be made and the contents evacuated, the cavities partially filled with the mixture and immediately sutured. Or the simple puncture with a large trocar and cannula, or aspirator, may be employed. Either is infinitely preferable to drainage. The skin should be sutured by the subcuticular method, otherwise the sutures should consist of some non-irritating, *i.e.*, non-absorbing, material such as fishing-gut or silver wire.

A test for iodoform which is easily applied and differentiates iodoform-uria and carbol-uria is to add to the urine its own volume of sulphuric and nitric acids, then a little starch paste; the latter becomes blue in the presence of iodoform.

BIER'S METHODS OF TREATMENT BY INDUCED HYPERÆMIA.[1]

As the success of the treatment *practically* depends upon ascertaining first the exact degree of hyperæmia suited to each individual case, secondly the maximum duration of time the hyperæmia should be maintained, it follows that a very close watch must be kept upon every case during the earlier applications of the bandage or suction glass—the failure to observe the first effects of the treatment on the *individual* case is the most usual cause of non-success.

The second great cause of failure depends upon the almost universal belief in the shibboleth that the *vascular phenomena of inflammation* are evil, and anything which tends to produce or increase any of the signs of inflammation *cannot be good*.

Unfortunately, pathologists still include in these phenomena the stages of stasis and thrombosis, and thus perpetuate this erroneous view that *all the stages* of inflammation are evil and to be combated at all costs. On the contrary, the first three stages are most essential, and without them *resistance to infection* is absent; they should be styled *hyperæmia*, and are manifest clinically by *redness, heat, swelling*, and almost every method of treatment which produces these clinical signs is used successfully in the treatment of diseases—fomentations, blisters, friction, massage movements.

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[1] Reprinted, with alterations, from *Folia Therapeutica*, April 9, 1909, vol. iii., No. 2.

The four methods of treatment adopted by Bier, when properly applied, result in this trio of symptoms, and without going further into the question whether the congestion *ultimately* attained by the bandage and suction glass is or is not arterial, *stasis* in the blood-flow must never result.

The Modes of Application.

(1) By graduated constriction by means of an elastic bandage.

(2) By intermittent suction of specially constructed cupping glasses.

(3) By the use of hot, dry air.

(4) By Kuhn's mask (in pulmonary phthisis).

Indications for Use.

(1) *Any infection, acute or chronic*, above which a bandage can be applied, or over which a cupping glass may be placed, or to which dry, hot air may be applied.

(2) *Sequelæ and complications* of infections, adhesions in joints, tendons, or other movable structures; chronic œdema; sinuses and fistulæ.

(3) *Contractions* due to trauma or paralytic lesions.

(4) To aid healing and prevent infection in un-

Advantages of Bier's.

(1) It may cut short an infection or abort suppuration.

(2) It always relieves pain, diminishes toxæmia, reduces fever. This protects the body generally, and promotes sleep and recuperation.

(3) If suppuration is present, it permits of successful treatment by means of less heroic measures, conserves bones, tendons and joints, and obviates mutilating incisions, scars, &c.

avoidable operations under dirty conditions—crushes, gun-shot wounds, &c.

(5) To keep down exuberant granulations and thus promote rapid healing.

(6) To stultify *recurrence from tissue soiling* during the performance of operations, especially in tuberculosis.

(7) To remove discharges from pockets.

(8) To enable much earlier and painless passive and active movements in joints to be carried out.

(9) To do away with plugging of wounds.

(10) To clear up latent diseases.

(11) To hasten the union of fractures.

(4) It always favours an ambulatory method of treatment, in contradistinction to confinement to bed, as movement in inflamed parts may be painlessly performed while wearing a Bier's bandage.

(5) It shortens the stage of disease, and hastens convalescence.

(6) It promotes absorption of inflammatory products and rapidly sets free necrotic tissue.

(7) It is a non-terrifying procedure, easy of application, and a most gentle manipulation.

(8) It is not costly.

General Precautions which must not be violated.

(1) Do not bandage or apply pressure on diseased tissue, but on healthy parts.[1]

Surgical Principles which apply to Bier's methods.

(1) All pus must be given vent to ;

(2) But small well-planned incisions suffice.

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[1] This does not apply to lymphangitis ; a bandage may be applied on the arm or thigh even if lymphatics are inflamed right into the axilla or groin, the inflammation above and below the bandage is benefited, the former by diminishing the ascending toxæmia.

(2) Always bandage at such anatomical sites as enable all the veins from the diseased parts to be subjected to pressure.

(3) Never produce pallor (anæmia), coldness, or pain in any part.

(4) Never produce any sensory changes.

(5) Always remove every other source of constriction or pressure. Therefore *remove* or loosen very freely all dressings.

(6) The pulse beyond must never in the least degree be impeded.

(7) Keep a constant look-out for new pockets or extension of disease.

(8) If no local reaction appears, *i.e.*, in the diseased part, first apply heat by fomentations for ten or fifteen minutes.

(9) Do not fear increased swelling and œdema in a part; they are essential, but—

(10) Never *re*-apply a Bier's bandage until all the swelling and œdema

(3) Never pack a wound with gauze, and it is rarely necessary to use a tube. If the edges of the wound tend to heal prematurely, insert a layer of sterilized oiled silk between them.

(4) If at the commencement of treating a wound or sinus the granulations are exuberant, cut them away and see the vent is free; they will not become exuberant under Bier's.

(5) Avoid irritant dressings, and do not use antiseptics; employ asepsis.

(6) Also avoid baths, wet dressings and fomentations when there are open wounds—use dry dressings.

(7) Keep the surrounding skin dry and clean with benzine or alcohol, and, if necessary to preserve dryness and *prevent contamination*, smear over it some thick emollient sterile ointment or vaseline.

(8) Use the minimum of force, do not probe,

induced by treatment have disappeared.

(11) Each case is a law unto itself.

squeeze, or swab unnecessarily, and never roughly.

(9) When a Bier's bandage is on, remove all other sources of constriction; a layer of sterile gauze or a sterile towel laid on the wound is the best dressing. The smaller the thickness of the dressing the better. The ideal dressing is *nil*, *i.e.*, protection from contamination under a sterile towel, otherwise free exposure to the air.

(10) Where tendons are involved, as in whitlow, do not incise vertically over the front of the digit through the overlying tissues and tendon sheath (or theca), as this permits the tendon to rise out of its bed, and *certainly die*; incise laterally or leave bridges of tissue to restrain the tendons *in situ*.

The elastic bandage should preferably be the special bandage without selvedges[1] (which produce injurious pressure), and not very strong, so that usually

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[1] Messrs. Mayer and Meltzer, Great Portland Street, will supply all Bier's apparatus.

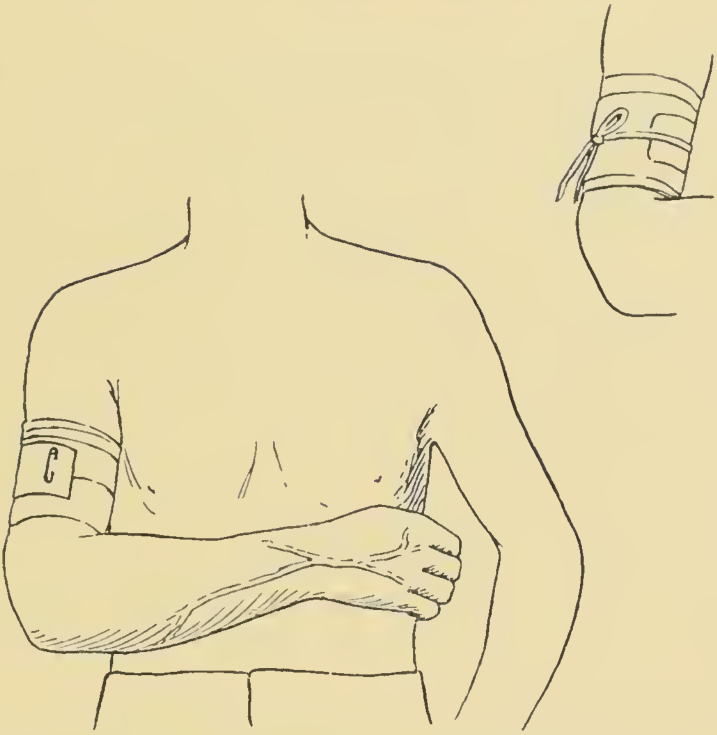

FIG. 103.—The bandage applied to the arm and fixed by a safety pin. Note the prominence of the vein. Inset, a bandage fastened by a tape.

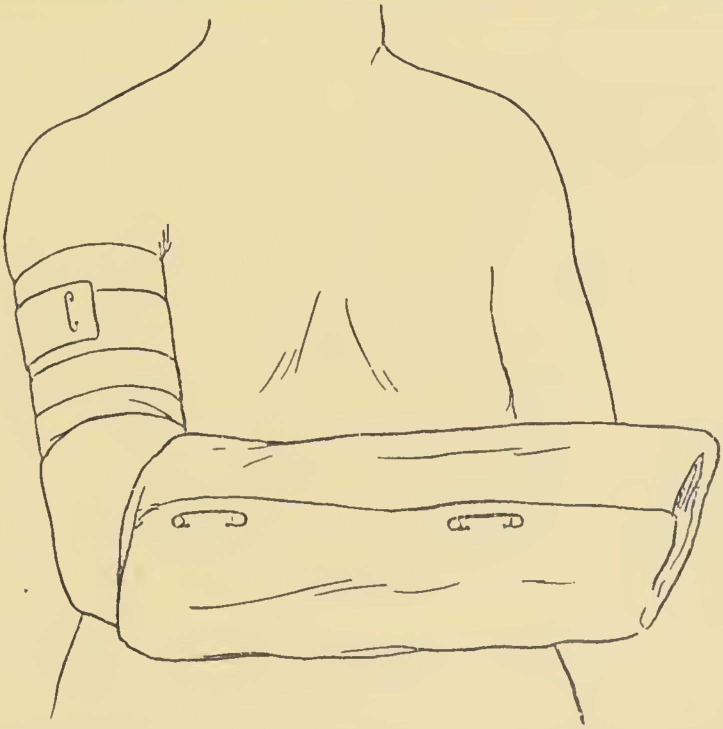

FIG. 104.—Shows the loose type of dressing used with the bandage. Note the swelling due to œdema below the latter.

several turns of the bandage are necessary to attain the desired compression, rather than one turn of a strong bandage, as it is highly desirable to diffuse the pressure exerted by the bandage, hence several overlapping turns, beginning from below, are best ; but in case of need, and generally when dealing with the head and neck, the scrotum and penis, or a digit, one turn may suffice. (Bier generally uses six to eight turns, each overlapping ½ in.)

For the upper and lower limbs a bandage 2 in. to 2½ in. wide is necessary, for the neck ¾ in., for a finger alone ½ in., for the scrotum and penis a thin-walled (*i.e.*) soft rubber tube serves best (the black rubber tubing formerly used for children's feeding bottles is excellent).

Children require careful observation, and bandages in proportion to their size and frailness, also it is invariably wiser to protect a child's skin by a layer of fine Saxony flannel or lint, and to gently massage the constricted zone after the bandage has been removed. As makeshifts, rubber rings serve admirably for small parts.

Before applying the bandage, note :—

(1) The degree of prominence of any veins.

(2) The colour and temperature of the skin.

(3) If there is a wound, the color of the granulations, and the amount and character of the exudation.

(4) Always feel for and note the arterial pulse.

(5) Any special peculiarities of the case.

(6) Ask the patient to observe the degree and character of the pain present.

What Degree of Tension should be exerted?

Candidly, I think it is quite impossible to say in any given case ; one learns by experience and observing the precautions formulated, but I would advise starting with a case in which there is an open wound or sinus, such as a whitlow; this should be carefully dried and a turn of the bandage applied above. In two to five minutes, if there is a definite exudation or moisture visible, the amount of pressure *is efficient for good*; if there is no visible exudation in two to five minutes the pressure must be increased, or another turn of the bandage taken, until exudation results.

One must remember that if a bandage is to remain *in situ* for many hours one must not produce a *copious* exudation in a few minutes; this I think usually wrong, and likely to lead to that greatest of errors, "overdoing" it.

Further, whatever the character of the discharge *previous* to the application of the bandage, purulent, sanious, or what not, the exudation which appears from the granulations in some five to ten minutes will be, *must* be, serous—clear, yellow, sticky. Remember, the quantity of exudation soon decreases and in many cases entirely ceases, although the wound might have been previously discharging pus freely.

The tension of the bandage should be successfully estimated at the first or second application and maintained at this throughout the treatment; errors of judgment, however, must be corrected at all times, also the bandage tends to deteriorate and may need tightening or renewing.

If there are obvious granulations a correct hyperæmia is induced when they show a bluish or deep red appearance.

In the case of lesions other than open wounds, such as the wound of an aspirating needle or trocar and cannula, or other lesion likely to lead to suppuration, or if one fears infection therefrom, a bandage should be worn, and the tension is now estimated on general principles, *i.e.* :—

(1) The compressing bandage or ring itself must never produce local pain (if this is really unavoidable its position must be frequently changed).

(2) It must relieve any pain, throbbing, or burning, felt by the patient in the injured part, within five to fifteen minutes (often this is instantaneous).

I strongly disagree with those who urge that fingers should be made "blue" on the application of a bandage. I believe the fingers stand in a class apart and react magnificently to Bier's, and should never be made so dusky as to lose the distinct red tint, except perhaps after many hours' treatment.

On the whole, I am not in favour of producing cyanosis in any part of the body as an *indication* of the degree of tension of the bandage. I think cyanosis, *i.e.*, blueness as distinct from *blue-red*, should only be present at the termination of the period of congestion. Thus the colour of the part beyond should, after five minutes, be only just perceptibly bluish-red, EXCEPT in those cases where the bandage is to be retained for a short period, say an hour, as in the intensification method for tuberculous joints, when the colour reaction should be better marked, and a speckled appearance should appear.

The Site of the Bandage.

In any lesion of the upper or lower limb beyond the elbow and knee, except a terminal phalanx, the bandage *must* be applied to the upper arm and thigh; further, it should be applied well above the condyles, preferably near the axilla in the upper limb and just above the middle of the thigh. When a terminal phalanx is involved the base of the finger may be constricted.

Having observed the precautions previously mentioned, take two or three turns of the bandage. Note if the veins are now fuller; or, if imperceptible before, are they visible now? Feel one. Is it too taut? If it can be fairly easily obliterated it is not; if, however, it feels incompressible the bandage is too tight. At the same time ascertain the patient's feelings. Is the *bandage* irksome? Does the diseased part feel more uncomfortable? If the patient says he does not mind the bandage, that it is comfortable and does not obtrude on his sensations, and, further, if he says the diseased part is more comfortable, *accept these points as the very best guide.*

After a short time feel the limb. Is it colder at its extremity (allowing for exposure, &c.)? If it is the bandage is too tight.

Is the skin slightly darker in hue and less pale? Is there any sensory disturbance?

Swelling and œdema appear after an indefinite period, varying with the anatomy and laxness of the tissue of the part; in the scrotum and prepuce it may be considerable, but in a finger, or on the head and neck, it *will and must be* inconsiderable.

Above all things, avoid increased pallor, coldness and any sensory changes; these must never result.

Thus, if the bandage is not irksome, if pain is relieved, if the veins are more prominent without being incompressible, if the limb retains its warmth (sometimes feels hotter), and, later on, œdema appears, and no loss of sensation occurs, the bandage is at a correct tension, and should be fixed by a safety pin, to be replaced later by a piece of tape sewn on to the last turn. **Mark the turns of the bandage** for future guidance, and see they correspond when replacing it.

In the case of the head and neck, an elastic fillet $\frac{3}{4}$ in. wide is made, encircling the neck once, to be worn as low down as possible. It may easily be worn unperceived under the collar by either male or female. After the correct degree of tension is ascertained a hook and eye, or a stud and button-hole, fixes the turn.

If the neck is plump, sufficient pressure will be exerted by the bandage on both the cutaneous veins and the internal jugular, as, owing to the contour of the side and back of the neck, the fillet appears to sit most comfortably just where the trachea begins to sink, and sufficient pressure for comfort is taken off the trachea by the sterno-mastoids.

If there is but little subcutaneous tissue or the trachea is relatively prominent, a flat pad about the width of and fitting over the sterno-mastoids, made of layers of flannel (or soft felt) of sufficient thickness and sewn together, must be used under the fillet.

The sensation of being choked, and interference with deglutition, must never be pronounced, and as the wearing of a bandage is occasionally only possible at night, it must never prevent sleep; in fact, *it must not be irksome*. At first all patients tend to resent the sense of even slight tracheal compression, and complain of fulness in the head, but a little patience soon enables them to overcome these usually emotional sensations.

If the bandage "rides up" two tapes may be sewn

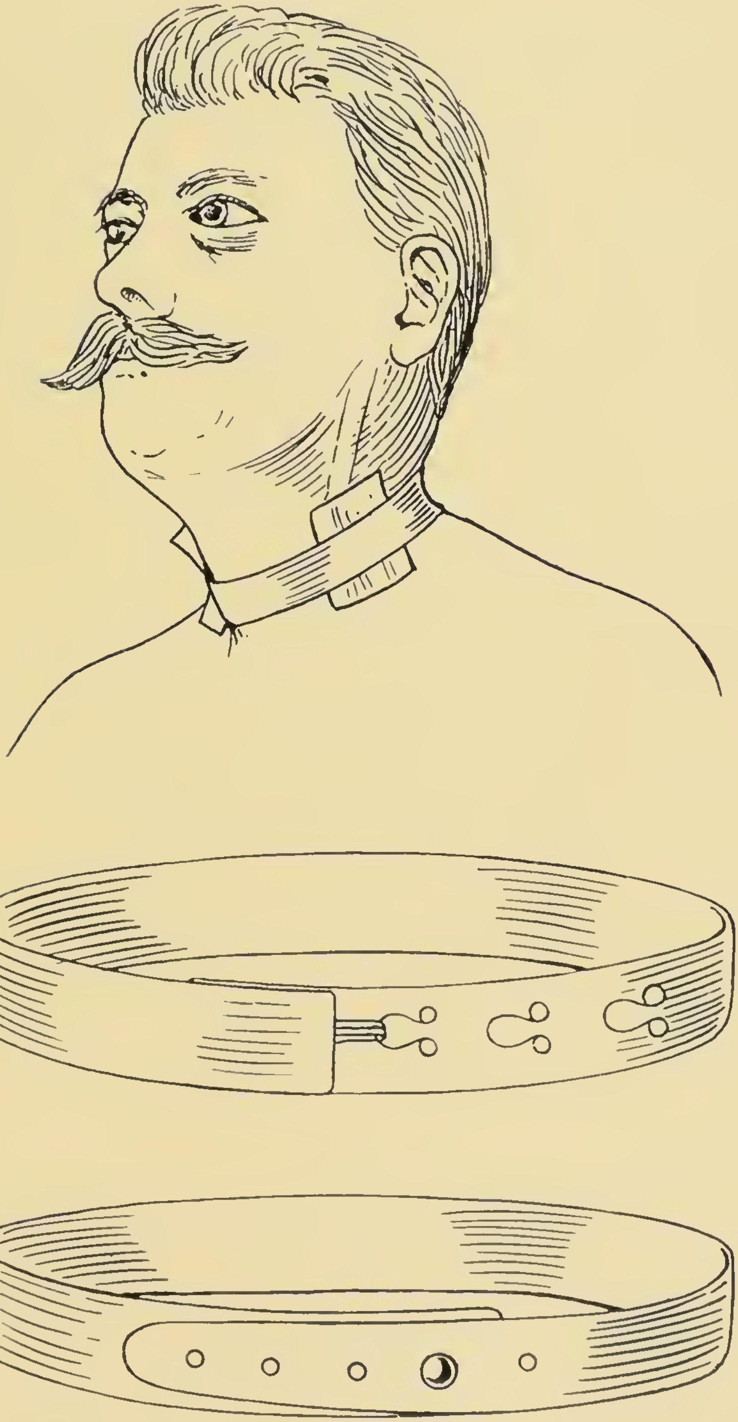

FIG. 105.—Shows an elastic bandage applied to the neck. A pad of felt or flannel is placed over the jugulars. The two modes of fixing the elastic bands are shown.

to it and passed under the axillæ. In this way tuberculosis of the upper cervical spine may be influenced, when the patient lies in bed with head extension applied.

The external jugular or the temporal vein serves as a visible guide to the surgeon.

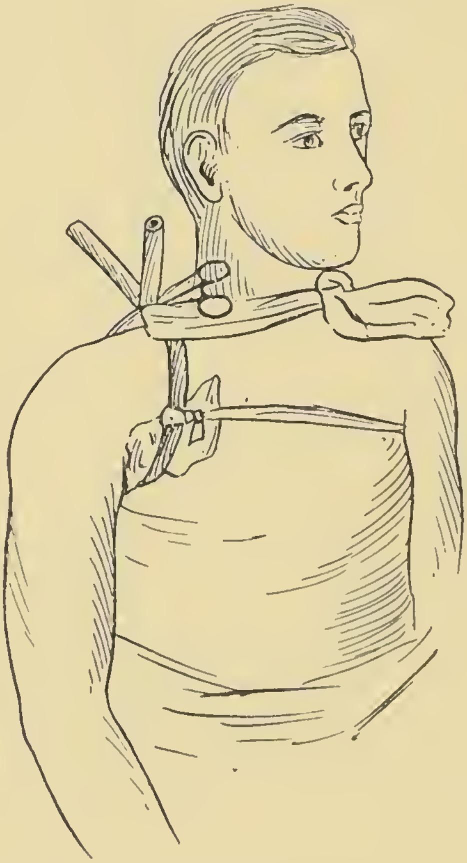

FIG. 106.—For shoulder and upper arm lesions. Instead of an artery forceps the elastic tubing may be tied with a piece of tape (see next fig.).

Similarly with shoulder and upper arm lesions high up, the elastic bandage (tube) may be supplemented by a soft wide pad placed over the situation of the subclavian or axillary vein, *i.e.*, it may be placed above and touching the clavicle in the hollow of the root of the neck or below the clavicle in the hollow just internal to the deltoid; the bandage, which has a tendency to slip off the shoulder, being kept in position as follows: A soft scarf formed of a skein of wool (or other suitable material) is worn, loosely fitting the neck, and through its bight the elastic bandage, or preferably $\frac{3}{4}$ in. bore soft rubber tubing, is passed; in addition, two tapes are fastened to the elastic bandage where it crosses the anterior and posterior axillary fold, and tied round the chest under the opposite axilla.

By regulating the loop of the scarf, the axillary tapes, and the tension of the elastic bandage, the latter may be kept at any spot desired, and the resultant compression regulated by the principles already mentioned.

An Esmarch tube tourniquet—*i.e.*, a soft, big $\frac{3}{4}$ in.-bore rubber tube—is best used for the shoulder, the axillary folds being protected by lint or wool.

The hip cannot be influenced by a Bier's bandage.

In the case of the *penis* and *scrotum*, soft rubber tubing serves best, but a rubber ring may be improvised. The penis alone, or the penis and scrotum, may be constricted together for penile affections; the scrotum alone for testicular and scrotal affections.

If only the anterior one-third of the urethra or the prepuce and glans are involved, the penis is slightly pulled away from the pubis and the ring slipped on (I find suitable broad flat rings difficult to procure), or the tubing is tied in place (see later).

If the scrotum is to be included, the tube, 8 in. long, is placed on the bulb behind the scrotum, and brought round to the dorsum of the penis; here a piece of tape is laid; across the tape, the two ends of the stretched tube *are crossed*, and the point of crossing tied by the tape. In an institution a bulldog clip may be used instead of the tape.

For testicular purposes the scrotum is gently pulled upon so as to form a pedicle, and the ring or bandage applied while so stretched.

If the bandage is placed on the penis alone the urethra beneath should be protected by means of a layer of soft material, but when the scrotum is included the latter serves this purpose; but the scrotum should invariably be protected by a layer of lint (the pedicle may be formed by a turn of the lint).

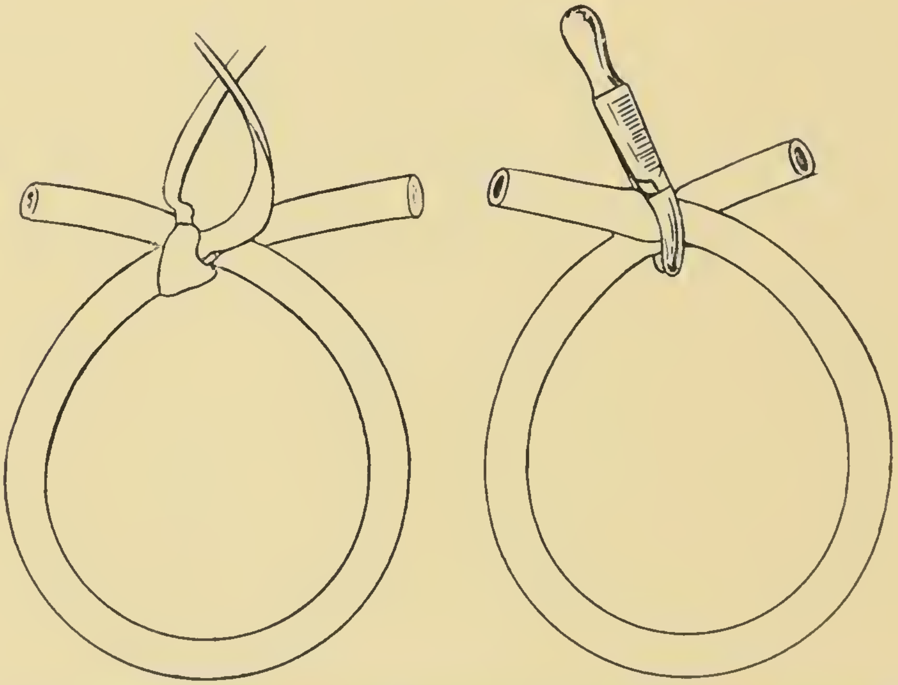

FIG. 107.—Shows the elastic tubing tied at its proper tension by a tape, or fixed by a bulldog clip.

The tension is estimated, as before, on general principles and by observing the fulness of the cutaneous veins, also by the relief afforded. The glans early becomes congested. In testicular affections considerable œdema of the scrotum must be produced after some hours of constriction, else the benefit afforded by the bandage appears to be very small.

In the case of early *gonorrhœa* the congestion of the glans should be fairly marked, and the bandage may be worn for ten or eleven hours continuously, day and night, micturition not being interfered with.

Take care the pubic hairs are not caught up in the bandage, or free them.

On first applying, wipe off the urethral discharge and observe carefully that in a short time it becomes thinner in consistence and clearer, and in a good reaction some drops of a clear, mucoid exudation will appear in a few minutes. At the end of this time the turgidity of the preputial veins and the glans should have ceased to increase, and there should be neither pain nor discomfort, else the bandage is too tight. Should the bandage become irksome, or micturition be impeded, it must be loosened.

The most suitable drug treatment to combine with Bier's is a mixture containing :—

℞	Urotropin	... ...	gr. v
	Tinct. hyoscyami	... ...	♏xx
	Aq. chloroformi	... ...	ad. ℥i

To be taken four times a day.

Also *restrict* the liquids so as to give the organ physiological rest.

General hygienic treatment and ample physical rest are required.

In posterior urethritis (superficial prostatitis) this method must be replaced by a suction glass to the penis and perineum.

The dose, *i.e.,* how long should the bandage be retained, as a general guide :—

(*a*) The more *acute* the infection the *longer—i.e.,* the more continuously—the bandage is worn ; the maximum duration is eleven hours out of every twelve, then one hour's intermission, or twenty-two hours followed by a remission of two hours.

The intermission is partly determined by observing the length of time necessary to permit the whole of the *induced* swelling and œdema to disappear. Slight elevation and gentle stroking may be utilized to facilitate its removal.

In some cases, after four to eight hours, the patient cannot longer tolerate the bandage, although no other evidence for its removal may exist. A trial of a new position may be made, and, if successful, the full time may be taken, but usually it is wiser to remove the bandage, and either make the time and tension it was tolerated the orthodox dose for that case, or else slightly decrease the tension in future and observe its effect.

(*b*) The *more chronic* the infection the *shorter* the application ; this applies chiefly to tuberculosis. The minimum dose *per diem* is one hour ; the average, two to three hours, the maximum six hours, either continuously or at two or more intervals. Recently Bier has crystallized the experience of his assistants and others with regard to tuberculosis into two methods :—

(1) The *moderate* congestion method.

(2) The *intensification* congestion method.

In the *moderate method* the bandage is applied with the tension as for a septic process (see *ante*).

(1) This is worn for three to six hours for some

days. (The latter period is rarely if ever exceeded in tubercular cases). The main effect produced is the relief of the pain in the joint, which is maintained even in the intervals when the bandage is not worn.

(2) Then the time is reduced one half for about ten or more days, after this it is

(3) Gradually reduced daily till a standard period of one hour per day is followed.

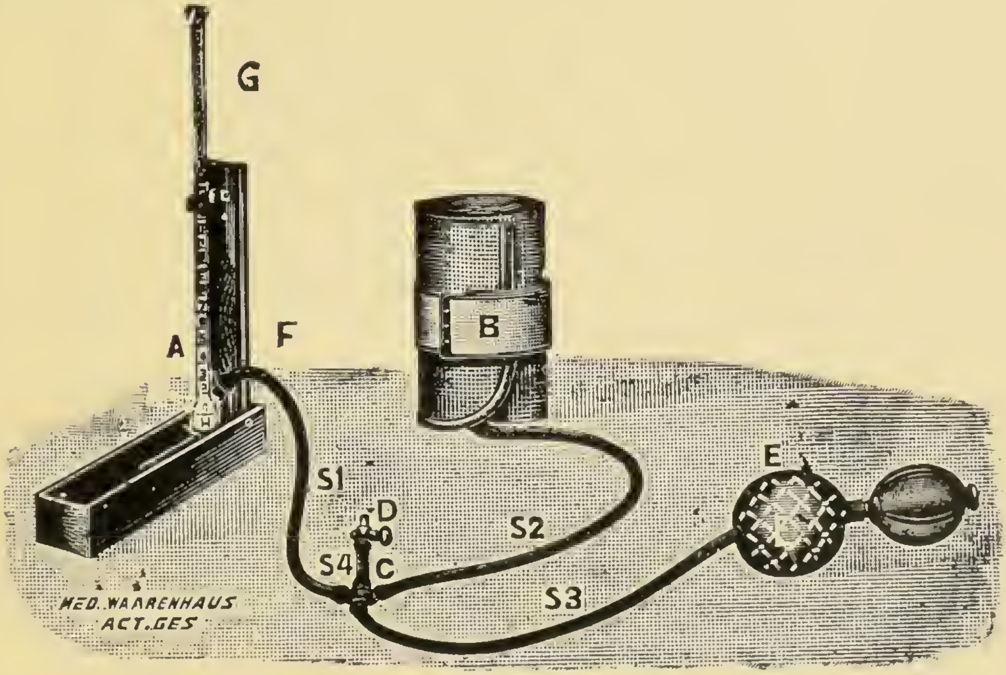

FIG. 108.—A pneumatic bandage with manometer for accurate re-adjustment of the pressure.

Obstinate cases, however, may need a two or three hours' dose instead of the hour dose.

For further details see p. 261.

My own custom with regard to tubercle has hitherto been to apply a lesser degree of constriction than if the case were a suppurating or septic case, and to wear the bandage one to two hours two or three times a day, taking particular note of the pulse and temperature, as well as the other conditions to guide treatment.

The sensations of the patient are most important, the relief of pain and the ability to permit slight passive movements while the bandage is *in situ* being most helpful both as guides and therapeutic measures. In this method I very seldom induce a well-marked colour reaction in tubercle, but if it is sought the tuberculous area should be fomented or bathed in hot water for ten to fifteen minutes, or a hot-air douche given for ten minutes before applying the bandage.

Occasionally œdema is easily obtained, and is, I believe, of good prognosis.

The *intensification* method.—The bandage is applied for one hour so firmly that "a vigorous congestion hyperæmia is produced." The subcutaneous veins swell considerably and the skin becomes bluish-red. At the end of the hour a slight prickly sensation may be felt, but *never pain nor vermillion spots.* The limb swells perceptibly but no œdema appears. (See p. 262).

I have used this method for over two years with fairly uniform success, and think it is the better plan in *experienced* hands.

It is with regard to tuberculosis that the most divergent results are obtained, and in which the individual factor of the practitioner tells most.

Hyperæmia by Suction.

Bier's suction glasses are simply cupping glasses suitably shaped and adapted, with a hollow stem for the attachment of a special device for aspirating the air, and thus producing suction.

The variety of shape, size, and finish is now legion.

In the case of very large glasses, enclosing whole limbs, and also occasionally on small glasses for treating the penis or fingers, rubber diaphragms or cuffs

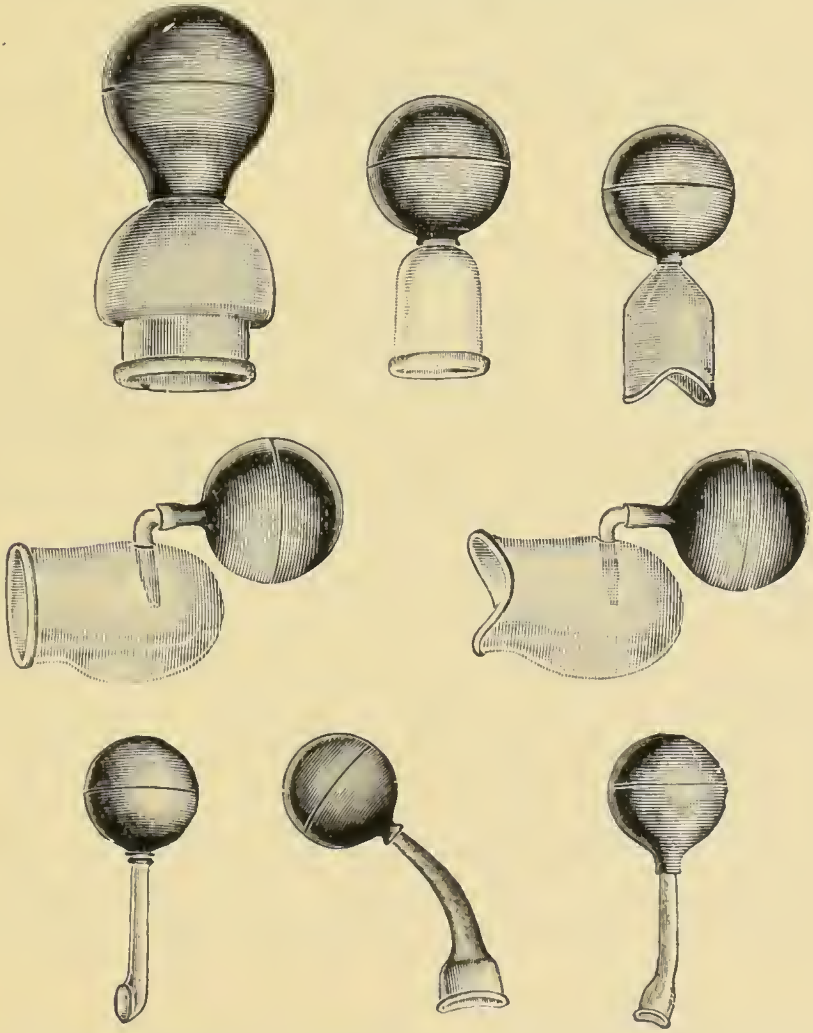

FIG. 109.—Simple forms of suction glasses with direct attachment of the rubber bulbs.

are fitted over the rims, and through a hole in the centre of the cuff the limb is passed so as to secure an absolute air-tight fit; it may, indeed, be necessary to secure the cuff firmly to the limb by a turn or two of bandage.

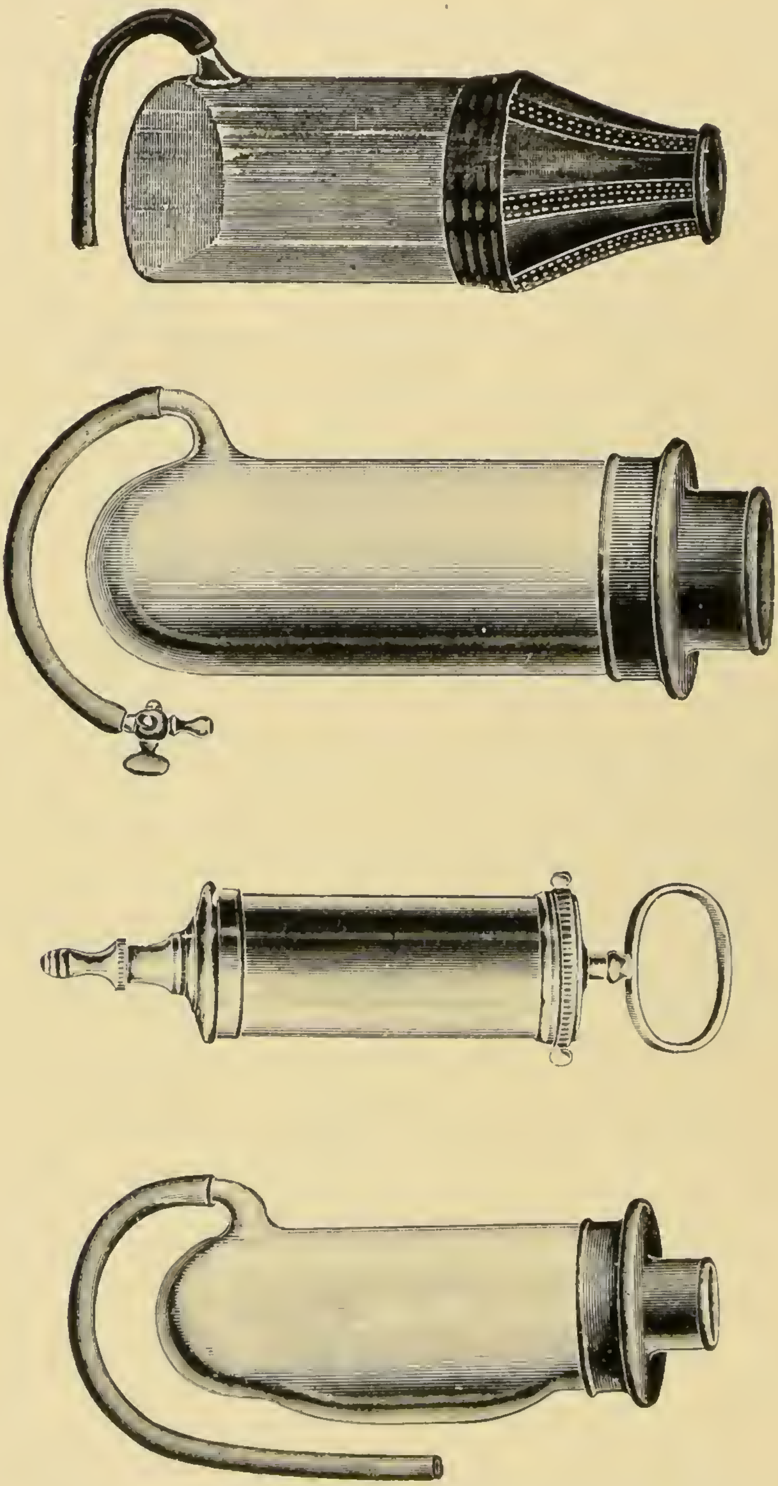

FIG. 110.—Various forms of glasses and rubber cuffs. The syringe is connected with the stop-cock by a length of rubber tubing.

For orthopædic purposes where contractures exist, and to effect movements in ankylosed or stiffened joints, a result which is obtained with wonderful freedom from pain, very elaborate glasses with interrupted spaces, or windows, covered in by strong rubber sheets (diaphragms) and containing intricate mechanical apparatus, are used; these, however, are sufficiently described by the illustrations.

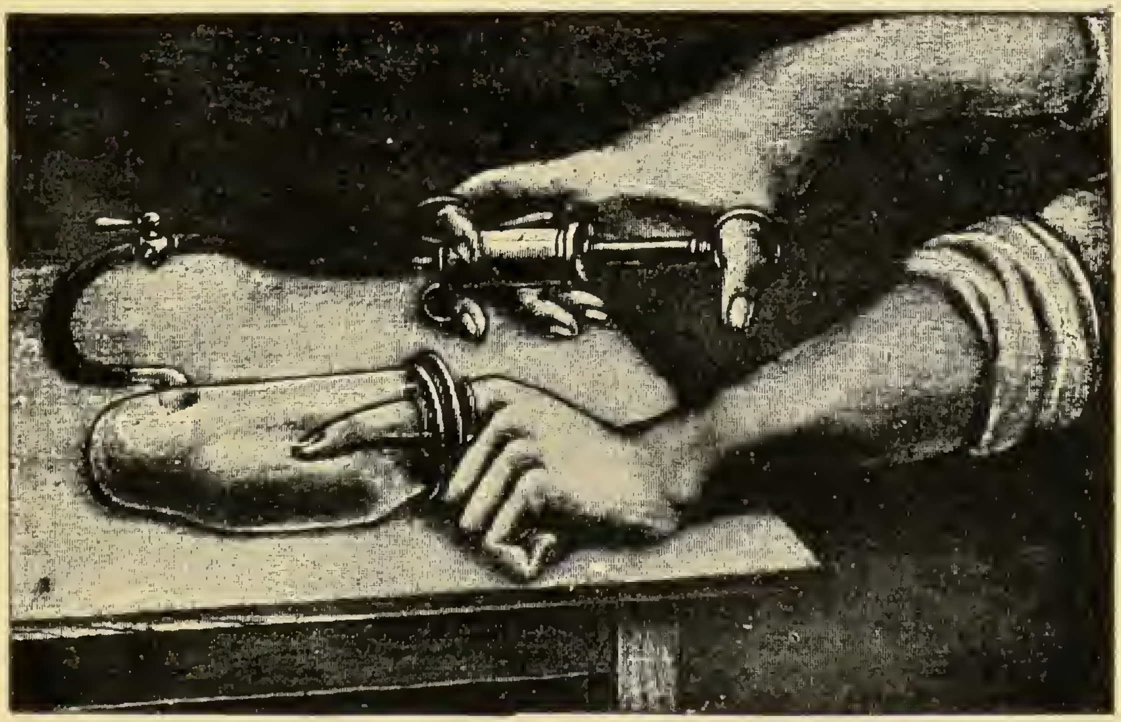

FIG. 111.—Treating a whitlow.

There are two methods of producing aspiration :—

The *simplest* is by means of a rubber bulb attached to the hollow stem of the glass, the degree of aspiration, and consequently of suction on the tissues, being in proportion to the degree the rubber ball is pressed when the glass is applied over the diseased area.

The other method is by means of a suction pump (a thoracic aspirating pump) attached to the glass by means of strong rubber tubing. On the rubber tube a three-way stopcock is fitted, so that the degree of suction can be regulated to a nicety and the apparatus removed without discomfort or difficulty.

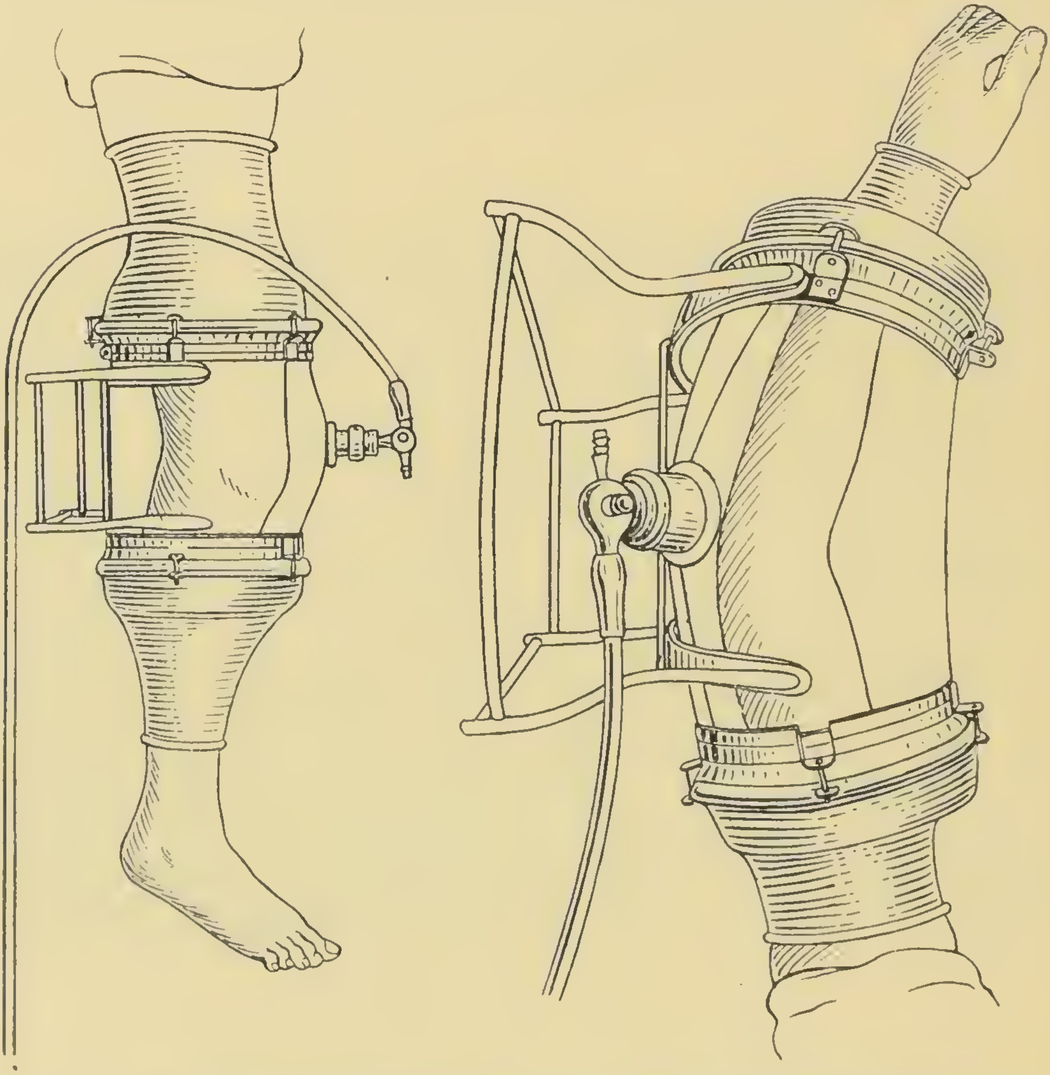

FIG. 112.—Bier's orthopædic glasses, for breaking down adhesions and applying movements to joints.

Special shaped glasses are available for different parts of the body, and the rims are made so as to

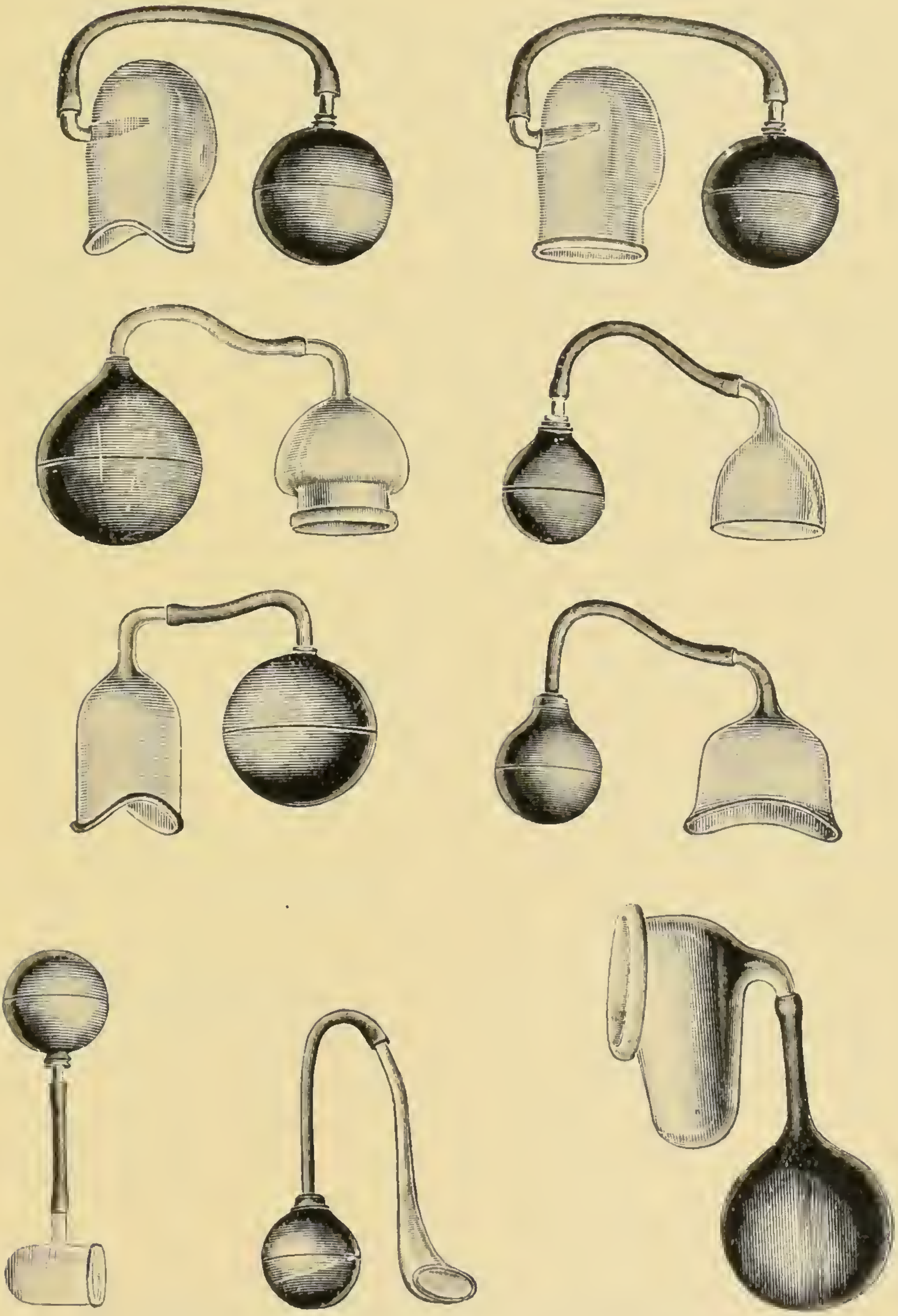

FIG. 113.—Various shapes of glasses and rims are shown. The bulbs are connected by a length of rubber tubing, as this is sometimes a convenience.

secure close apposition to the varying contours of the part, accurate apposition being a *sine qua non*.

Where the rim may, of necessity, have to rest on bone one side and soft tissues on the other, pneumatic rubbers, similar to those on the face-piece of anæsthetic apparatus, may be attached to the glass.

What size Glass should be used.

The diameter of the glass should exceed that of the diseased area, but it is not desirable that it be more than will easily embrace the diseased part, *i.e.—the pressure of the rim must be exercised on healthy tissue.*

In this connection it is necessary to see that the thickness of the rim is considerable, so as to diffuse the pressure, as the rim actually performs the same mechanical function that the elastic bandage does—namely, *it compresses the venous system,* and what applies to the bandage applies equally to the glass.

How to Estimate the Suction.

When a glass is applied under suction the tissues are drawn into it, forming a dome-like protrusion, reddish-blue or mottled in colour. Colour reaction is always marked in this method, and indicates considerable venous obstruction which, if long continued, would be injurious, hence the method of treatment is carried out *intermittently*.

If the suction is too great (or too suddenly applied) the skin may become a very dark blue and petechiæ may appear, also *pain* is experienced, and it is by estimating the degree of discomfort—*i.e.*, its absence—and never losing the *reddish* tinge in the skin, that in a short time the practitioner arrives at an estimate of the correct degree of suction.

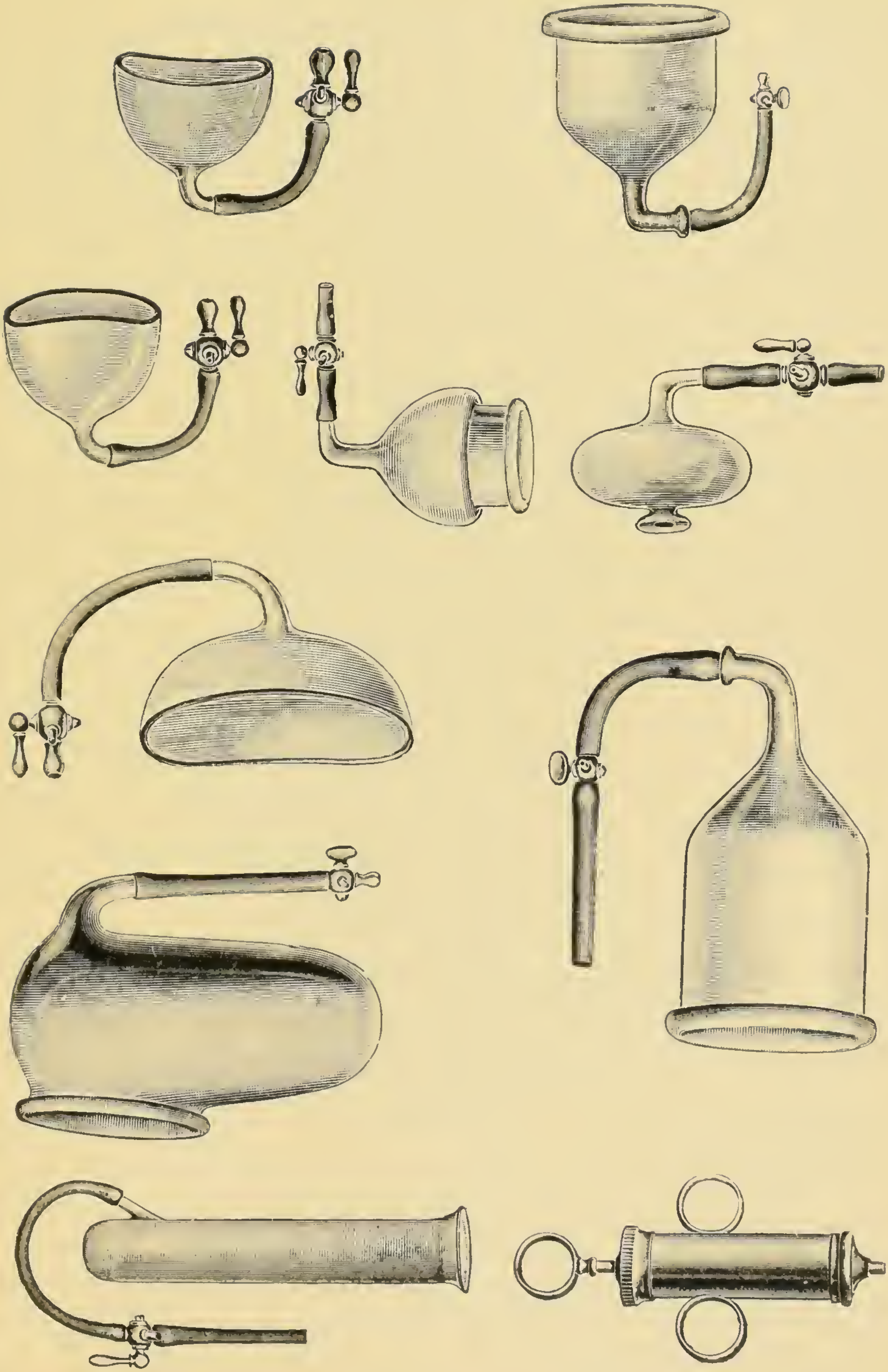

FIG. 114.—Glasses showing different forms of rims and shapes; with pump attachment.

Real pain should never occur, but in very inflamed parts the feel of the suction may amount to discomfort, which, however, in a minute or two quite disappears.

(1) A moderate-sized "dome."

(2) A reddish-blue colour.

(3) An easily tolerated but definitely felt suction, are the trio of signs one goes by.

(4) These are added to in the case of furunculæ, open wounds, &c., by observing that the serum which exudes is *not blood-stained* or rapidly ceases to be blood-stained.

The dome of tissue should never be, or become, pallid, which, of course, indicates interference with the arterial supply (anæmia). Pallor and Bier's are incompatible.

With certain open wounds so readily do the granulations bleed that a definite pink tinge in the exudation may be unavoidable, but as they become healthier this slight bleeding is more easily avoided.

The Application and Dose.

If the glass is a small one with rubber bulb, squeeze the bulb about half empty, apply the rim firmly on healthy skin beyond the diseased area, which should be as near the centre of the glass as possible, GENTLY RELAX the bulb and note the dome of tissue as it develops.

If the suction does not produce pain, and the dome is a *reddish*-blue, all is well.

The size of the dome is not always a suitable criterion, as it varies with the density of the tissue and the type of inflammation present.

The glass is allowed to *remain on for five minutes* and then removed. To take it off, gently squeeze the bulb, the dome disappears, and suction ceases.

The glass is at once cleansed by wiping it, and immediately placed in boiling water for one minute, then taken out and placed on a sterile towel to cool.

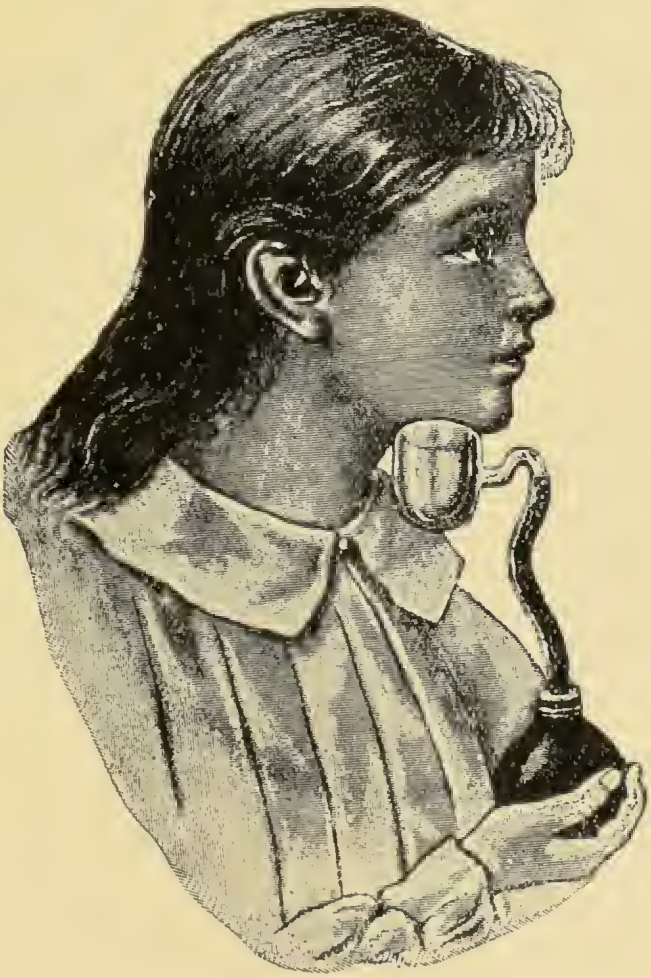

FIG. 115.

Three minutes after its removal the glass is reapplied.

Thus suction is maintained five minutes, then an intermission of three minutes; repeated for six applications, the séance consisting, therefore, of thirty minutes' suction and fifteen minutes' intermissions. But a slavish adherence to this dosage is unnecessary.

Treatment is usually carried out once daily, but under certain conditions it is wise to make three to six applications in the morning and again in the evening, the result of treatment and the physical condition and progress of the patient determining this question.

As both bandage and glass protect the body generally from toxæmia, which is proved by careful note of the pulse and temperature during and after treatment, I believe in a more frequent application of the glass with a slightly lesser degree of suction. The patient can easily be taught to carry out the evening or morning application.

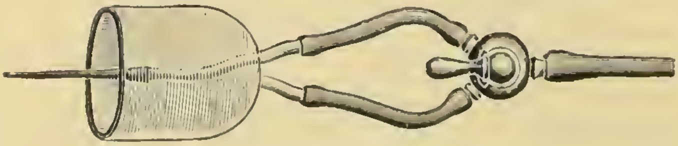

FIG. 116.—A suction glass for the treatment of fistulæ. The central stem is introduced into the track.

With the larger glasses the pump expels the air while the glass is held *in situ*, rapidity of suction is avoided, and an accurate degree of suction can with certainty be obtained; by gently opening the stopcock air is admitted at will, and thereby the pressure varied from time to time, or, if an excess of aspiration has been induced, this may be corrected. Also to remove the glass the air is gently admitted.

Certain details are important. (1) *That of infection and reinfection comes first.* — By the fomentation method of treating furuncles and suppurating wounds it is unquestionable the practitioner *prepares* the adjacent skin for infection by *soddening it*, and to it there is then conveyed virulent bacteria from the original focus, by spread of the discharge along the surface of the fomentation, and so treatment perpetuates the original trouble; likewise with acne and other lesions of the skin. With a Bier's glass damage may be done unless (*a*) the rim is broad and smooth; (*b*) scrupulously sterilized by boiling; (*c*) and the skin protected from any discharge which may exude and contaminate its surface. This is best avoided by smearing the skin around the wound with a thick aseptic and sterilized unguent, preferably vaseline. The unguent also helps to procure a perfect air-tight fit. It may be removed, if necessary, by benzene, ether and alcohol.

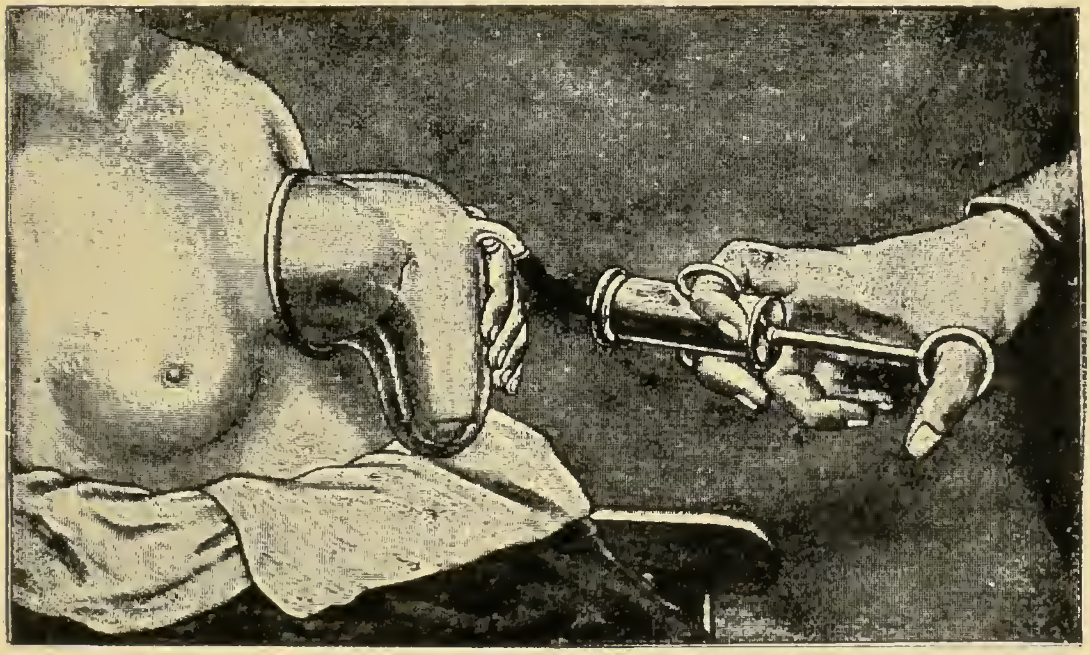

FIG. 117.

A vessel of boiling water must always be at hand.

(2) *The After-treatment.* — My experience indicates without question the avoidance of both wet dressing and antiseptics. Therefore a *dry sterile gauze* dressing without any wool, and the minimum of bandaging, is best. If wool is essential on account of copious discharge it should not be a thick pad. Free circulation of air appears to me to be highly desirable, and if a patient can be so managed as to do *without any dressing at all*, the discharge being mopped up from

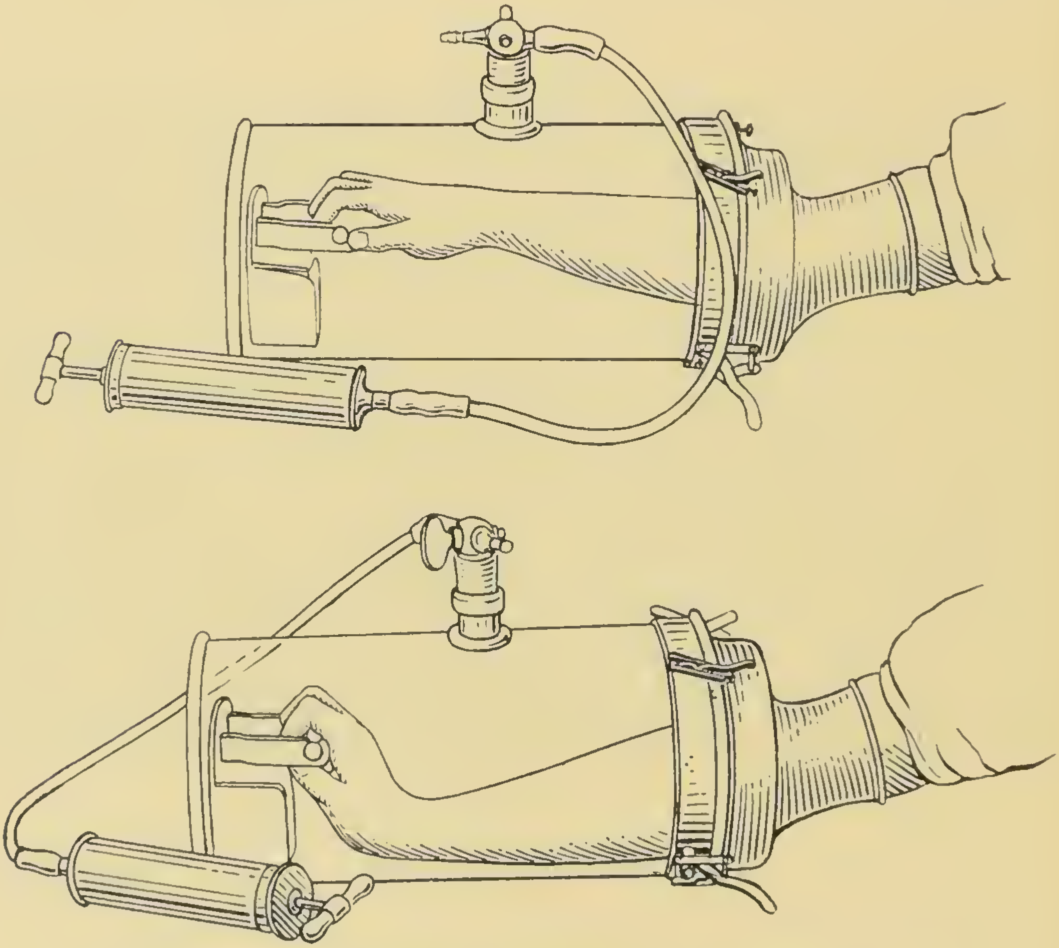

FIG. 118.—Effecting dorsiflexion at the wrist.

time to time with a sterile swab, great benefit will accrue. Thus a minimum of dressing material frequently renewed should be aimed at. At night a gauze dressing must be worn. Keeping the surrounding skin dry by the above measures, supplemented by occasional swabbing with alcohol, is an excellent adjunct to the treatment of all wounds. Towards the later stages, or if it is essential for the patient to be about—*i.e.*, out of house—the gauze dressing, or a dressing of some thick non-irritating sterile ointment spread on lint with a hole in the centre for the discharge to pass through, and covered by sterile gauze, acts very well. By sterile gauze I mean one free from antiseptics and sterilized by heat.

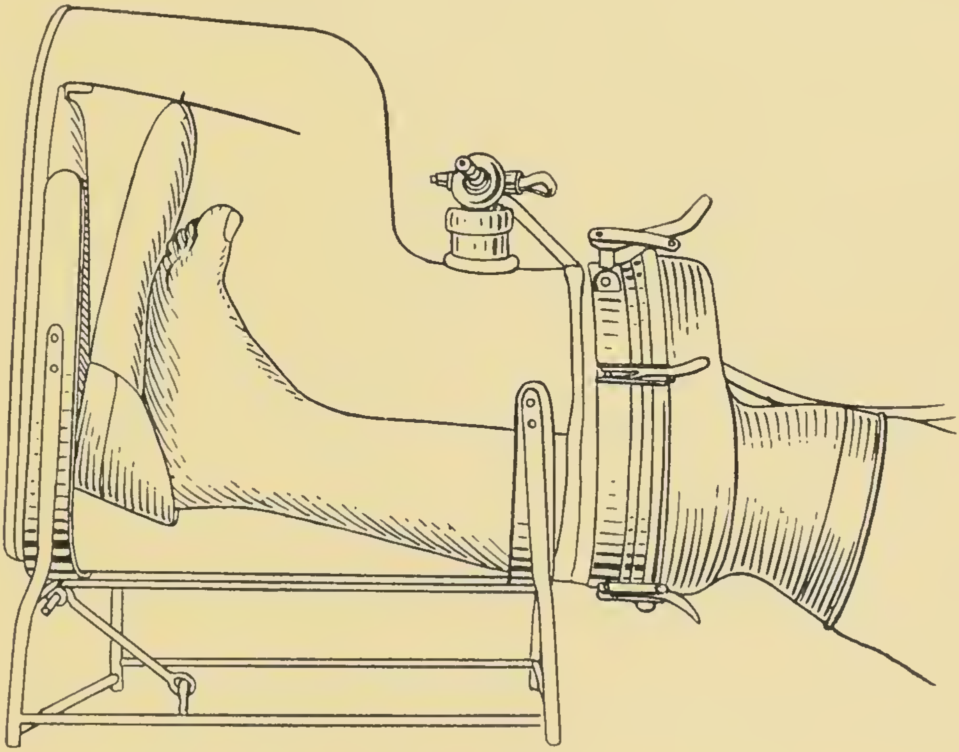

FIG. 119.—Suction producing dorsiflexion at the ankle and tarsal joints.

(3) If an abscess is to be opened a small but *efficient* incision or puncture suffices, and the glass may be applied at once. The bleeding soon ceases, and the pus and minute sloughs are removed quickly. Within a few days the discharge diminishes markedly, or even ceases, and healing is rapid.

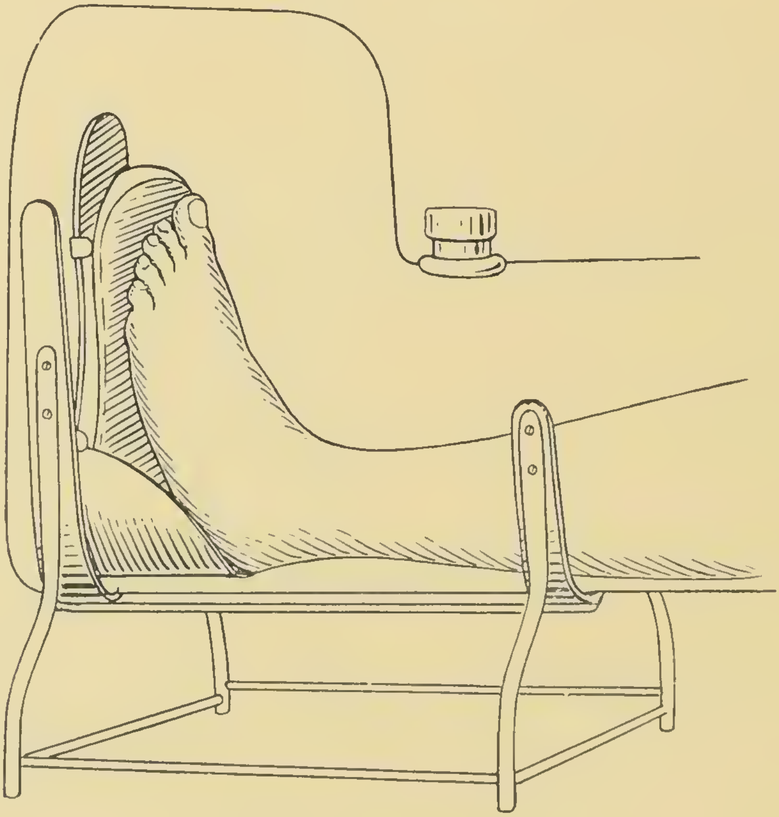

FIG. 120.—Producing inversion of the foot.

To keep the orifice open should it tend to close too soon. Do not pack with gauze, but pass a strip of sterilized oiled silk or rubber tissue between the edges of the wound. In case of large abscesses I believe in a freer opening, so as to obviate wearing a tube; healing takes place so much more quickly under Bier's methods that prolonged drainage is unnecessary.

The question of boiling the rubber bulbs and tubing of the apparatus is to be treated on common-sense lines ; if they are soiled certainly they must be.

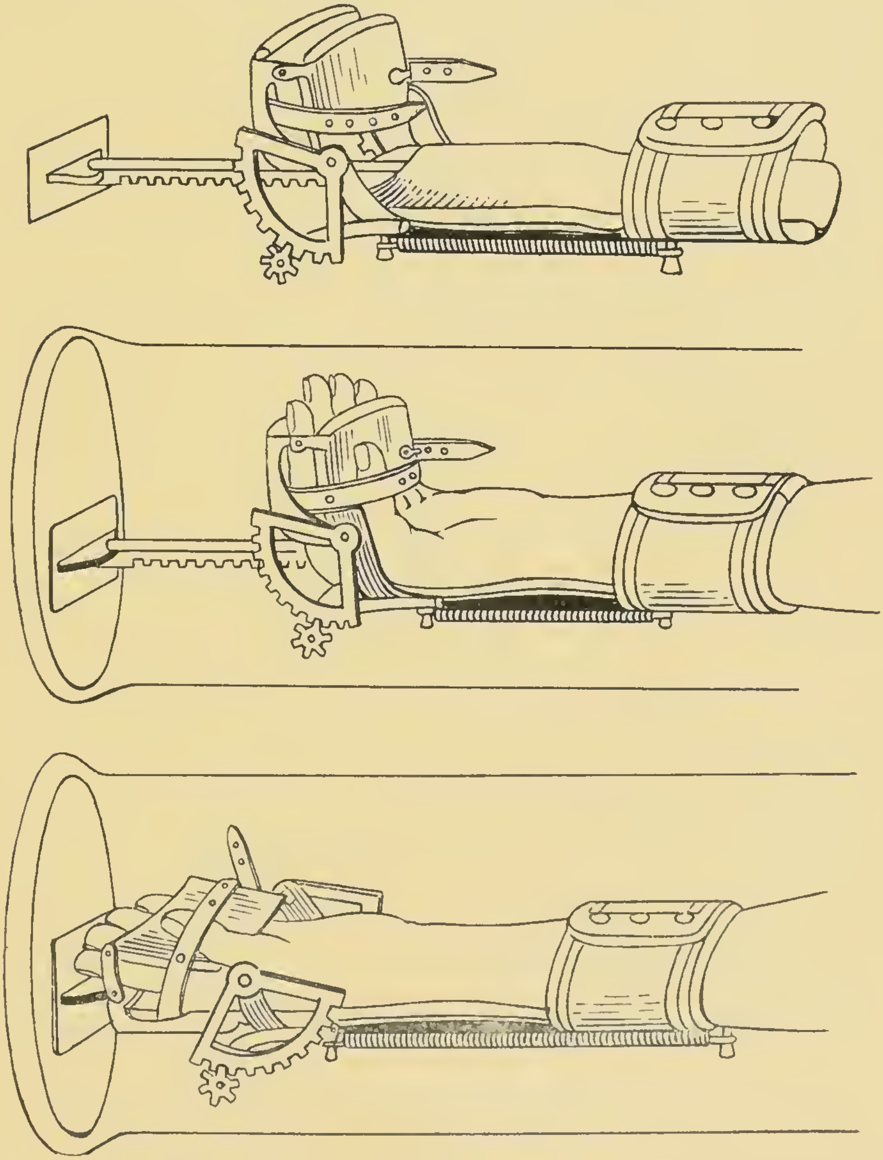

FIG. 121.—The details of the apparatus for effecting extension of the wrist and hand.

It is maintained that the physiological effect (hyperæmia) of a suction glass extends to a depth of

2 in. and, therefore, can reach any point in the limbs and parietes, also certain viscera.

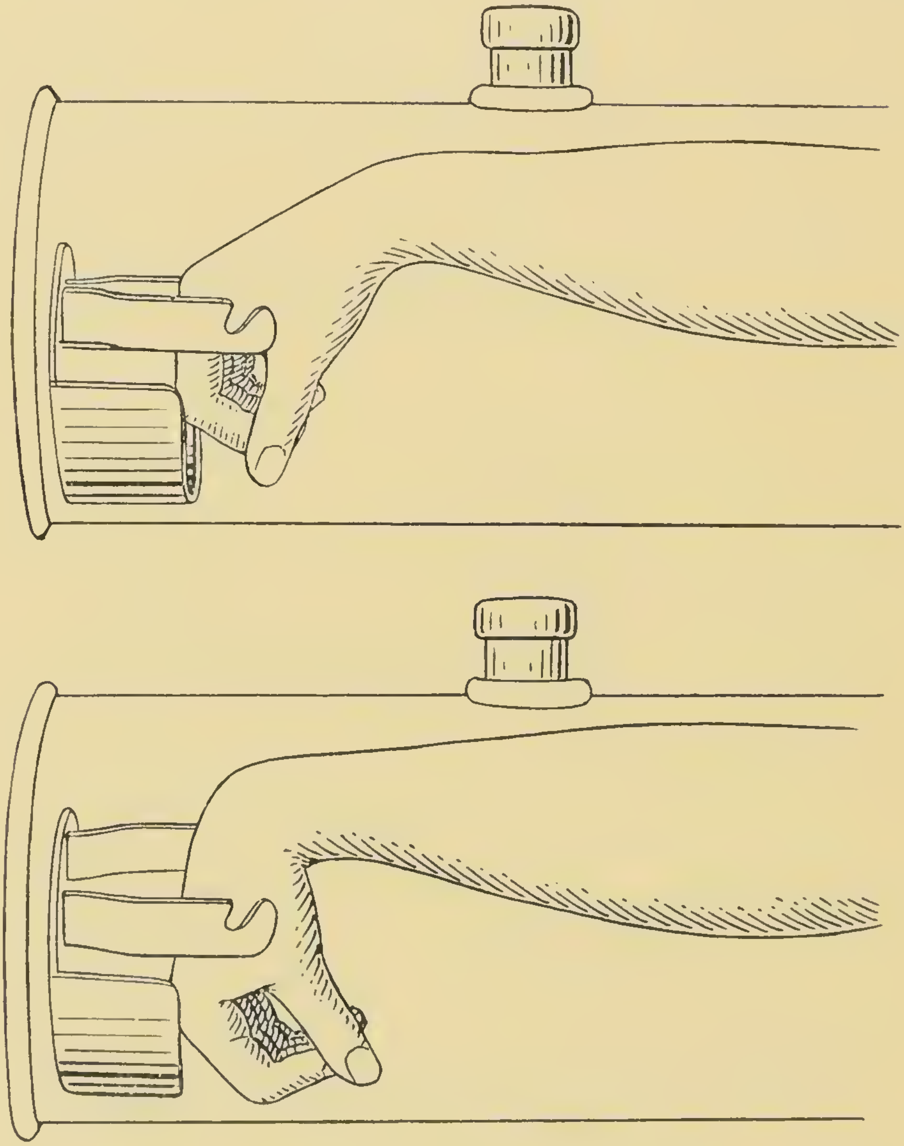

FIG. 122.—Producing palmar flexion at the wrist.

Hyperæmia Induced by Hot Air.

Hot air may be employed to induce hyperæmia in two ways :—

(1) In a hot-air chamber.

(2) As a hot-air douche.

(*a*) Dry heat generated by a gas ring, a bunsen, paraffin lamp, electric bulbs, a spirit lamp; in fact, any form of flame *is the source of heat*.

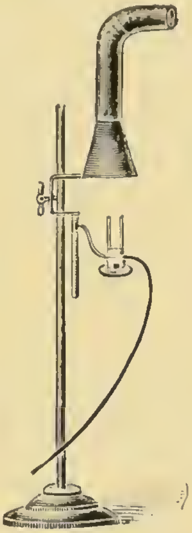

FIG. 123.

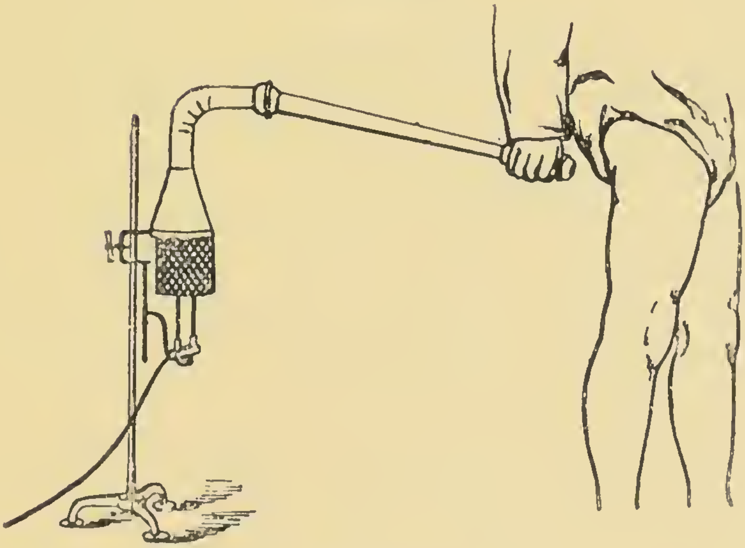

FIG. 124.

(*b*) This is *conducted* by a *funnel* of sheet iron or block tin placed over the flame, but raised above its level—*i.e.*, with a definite interval between.

If a *douche* is desired, to the end of the funnel is fitted a tube, 2 to 3 ft. long, which gradually tapers to a nozzle, and the hot air as it issues is directed to impinge on the part to be treated, the heat being regulated :—

(1) Partly by the size of the flame.

(2) Partly by the diameter of the funnel.

(3) Partly by the size of the interval between the flame and the funnel.

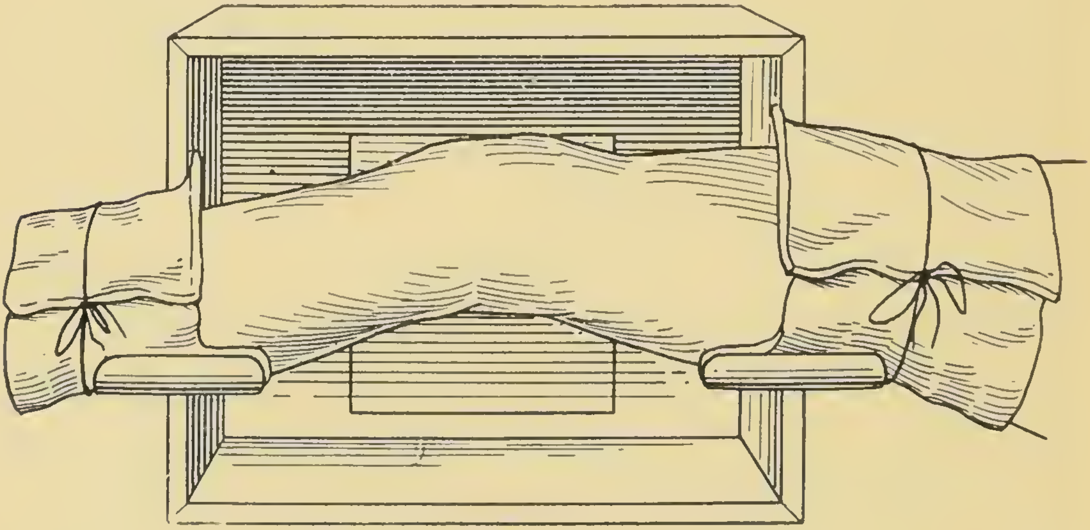

FIG. 125.—A leg in position to show the felt flaps which are fastened to the orifices of the bath to retain the heat, by being bandaged or tied over the limbs, and to prevent scorching of the skin by contact with the wood or asbestos.

(4) But chiefly by the distance the nozzle is held from the skin.

The degree of heat desired is the highest the patient can bear without pain or burning. An intelligent tinman or blacksmith can easily make the funnel ; the tube for douche purposes must be attached to the end of the funnel by a universal joint, so that the stream of hot air can be made to follow the course of a nerve or be otherwise moved about.

The hot-air chamber should be made of wood well seasoned, preferably free from resinous constituents and impregnated with waterglass.

Asbestos makes a perfect hot-air chamber material. It should be too large rather than too small. In the ends are holes lined with felt, prolonged as flaps, which can be bandaged on the limbs.

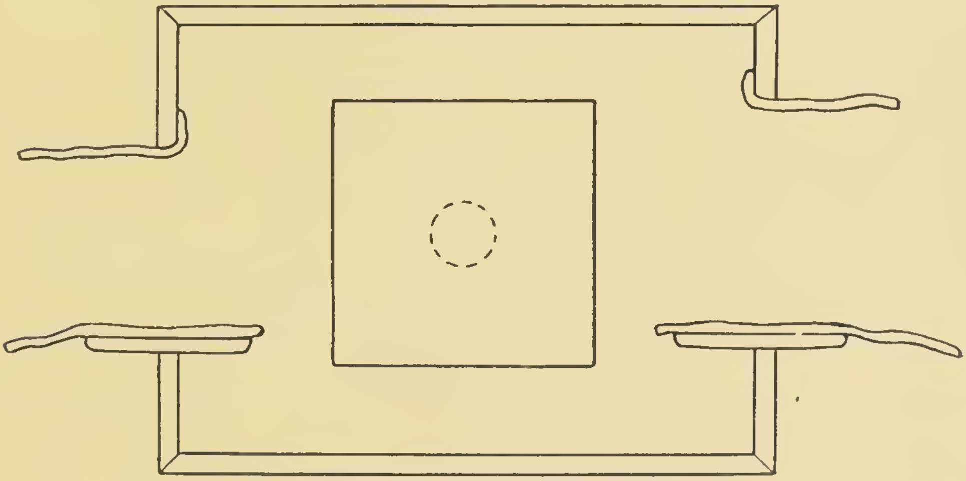

FIG. 126.—The leg removed to show the square piece of wood which is fixed over the inlet (dotted) for the hot air, to prevent it impinging upon the limb.

The roof should be made as a lid, or contain a sliding shutter for ventilation and evaporation, especially the latter, as the limb perspires freely, and the chamber should be kept dry, else the moisture interferes with attaining a high temperature and dry air.

The funnel is let into one side of the chamber, and to protect the limb from the hot air impinging directly on to it, and to diffuse the heat, a partition suspended from the side, but not reaching the bottom, should be fixed.

The toes and highest points in the box are especially affected by the heat, and it is always wise to wear a hood made of thick flannel or felt, over the toes, else they become extremely painful.

To apply the treatment the lid is raised, the limb passed into or through the box, and the felt cuffs bandaged on; the limb must lie comfortably. The ventilator is opened very slightly. The lamp or bunsen is now lit and *then* brought under the funnel, *otherwise an explosion may occur in the box*, and placed not too close to it. The temperature must be raised gradually, but neither pain nor real discomfort must be produced.

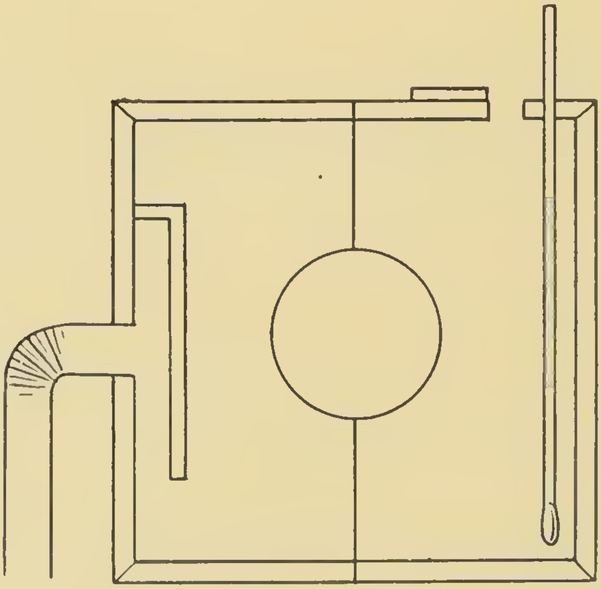

FIG. 127.—A lateral view of the box, showing on the left the inlet and safety board; above, the ventilator, slide, and thermometer; the circle represents an orifice for a limb.

Burns are easily produced either by contact with the wood, or when the escape of moisture is not sufficiently free, and are not felt, as such, when produced. Endeavour to ascertain the highest temperature which is best borne, and maintain constant by regulating the flame, the distance from the funnel, and the width of the ventilator.

Tallerman baths, when available, are ideal hot-air baths.

The dose of a hot-air douche is twenty to forty minutes daily according to the effect upon the disease. It should be started and finished gradually.

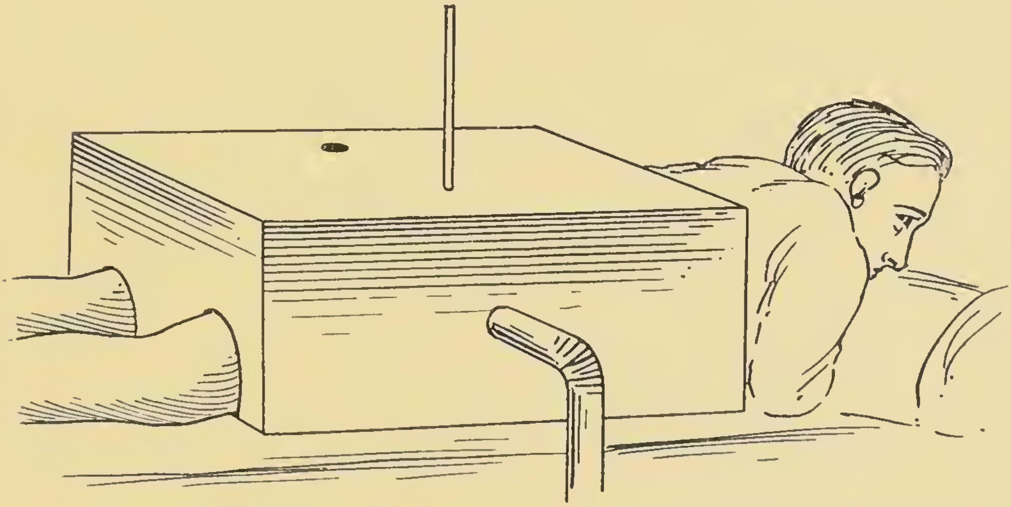

FIG. 128.—A hot-air bath for spine, sacro-iliac and hip joints and the neuritic symptoms they give rise to, such as sciatica and lumbago.

In the hot-air chamber a longer time may be given if it is well borne, generally not over an hour.

After hot-air treatment in the chamber the source of the heat is first removed, then the ventilator should be widely opened, and the temperature gradually reduced, the limb not taken out too suddenly, then well dried.

Hot-air treatment should *always be followed by massage* and the part kept swathed; limbs treated by

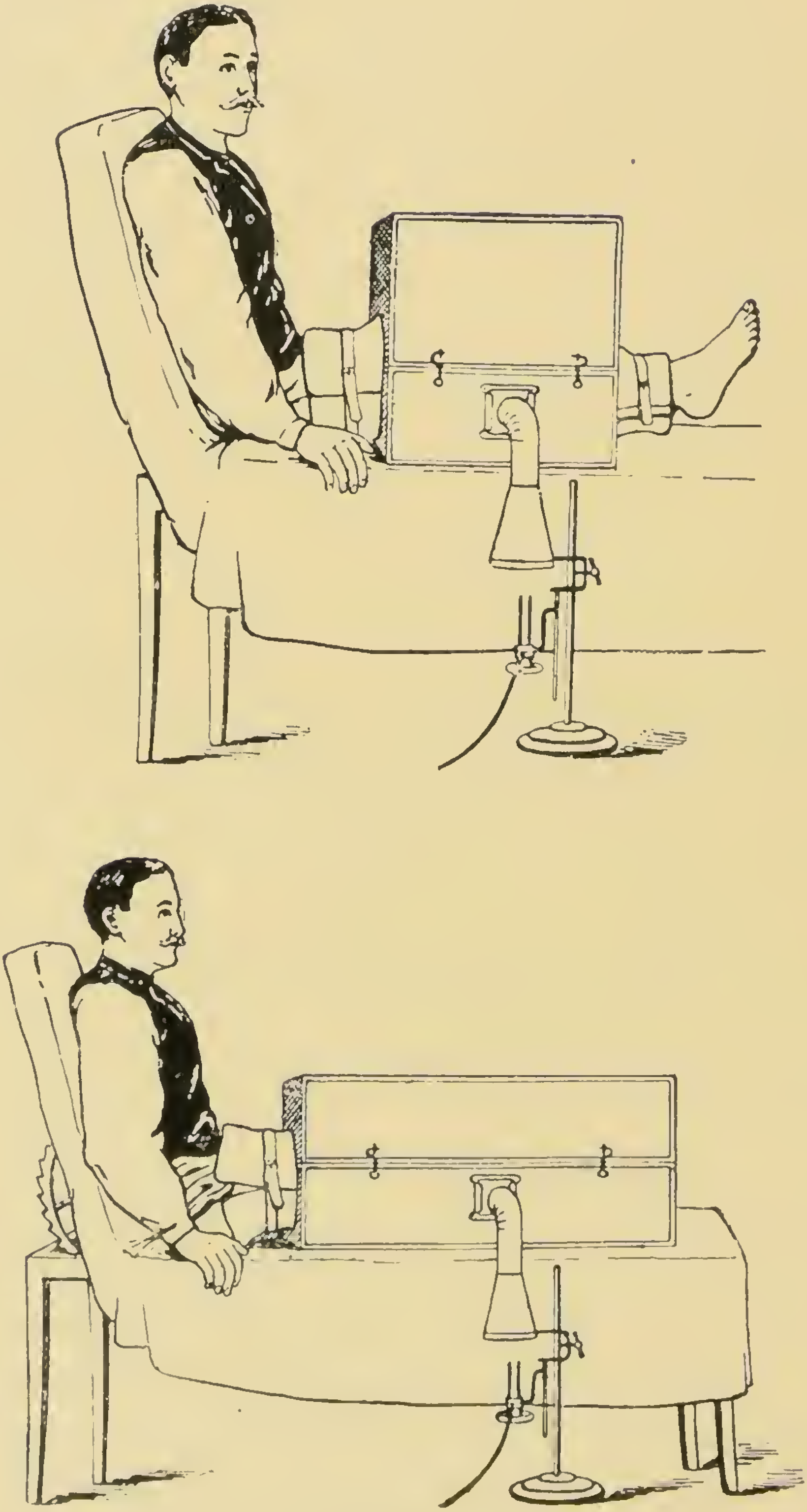

FIG. 129.

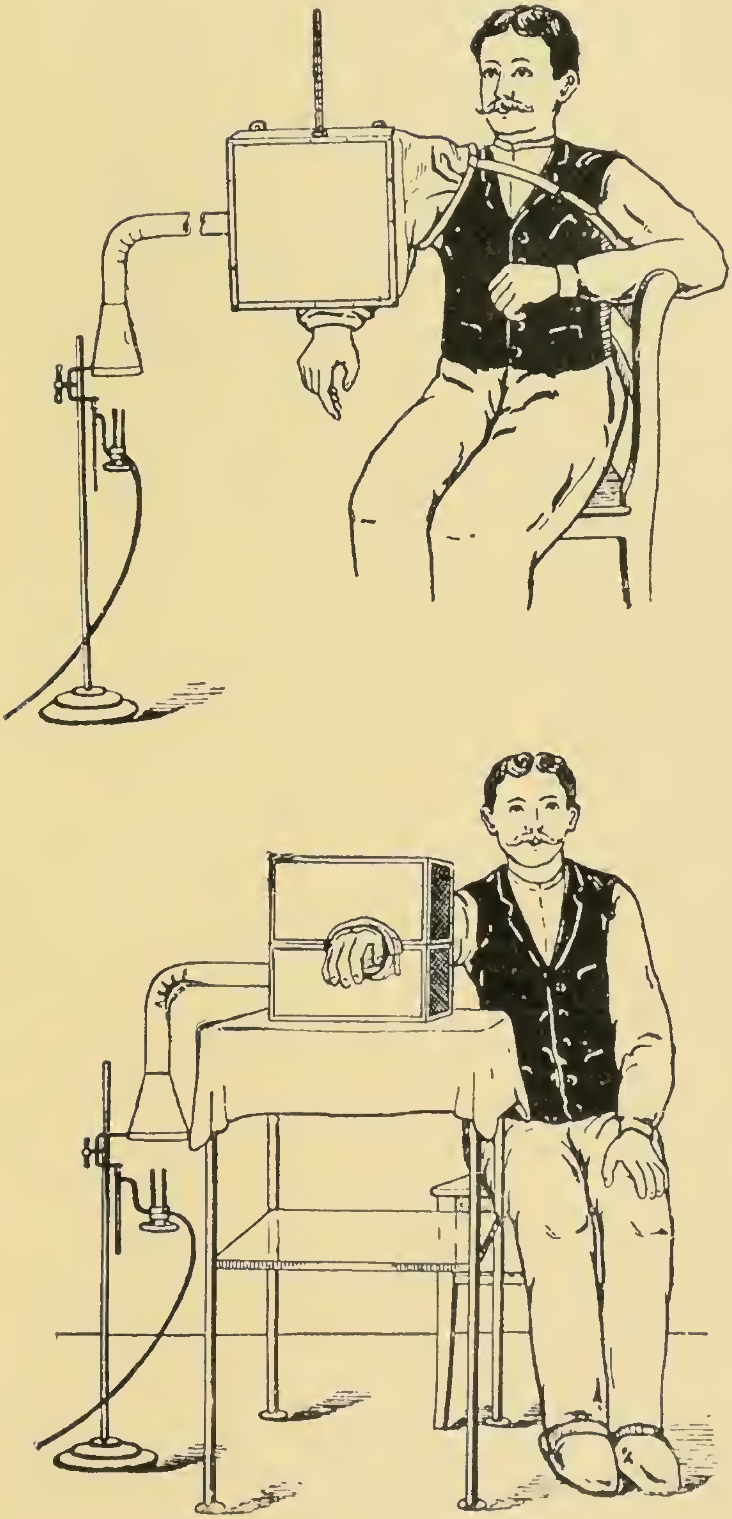

FIG. 130.

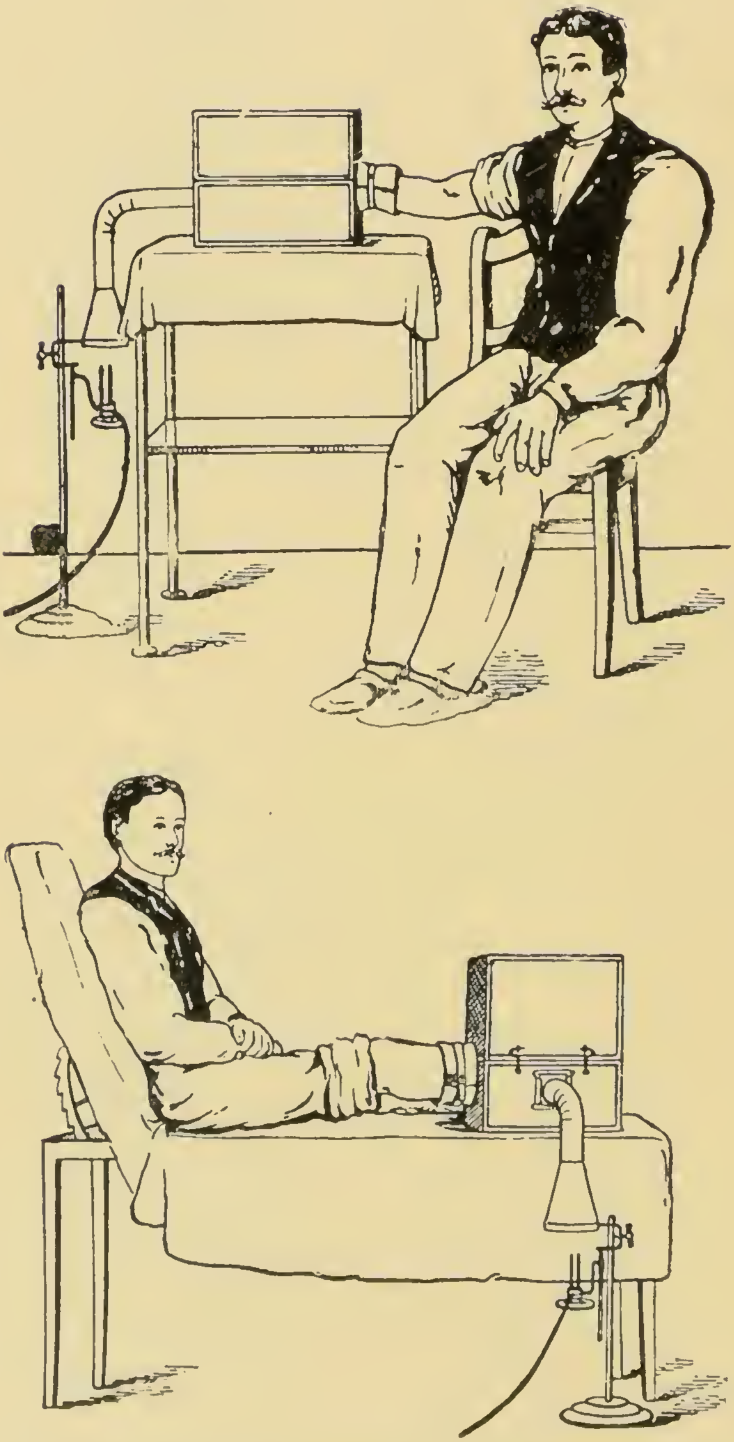

FIG. 131.—Various forms of hot-air baths. These are made of asbestos; they are cheap, strong, light and portable. They are also much safer than the wooden boxes.

Bier's methods are very susceptible to cold and must be protected. Occasionally a short exposure to douche or chamber may beneficially precede a Bier's bandage, except possibly in the case of tuberculosis. (See Osteo-arthritis, p. 116).

A little ingenuity only is necessary to devise boxes suitable to place over the body or hips and shoulders.

A few electric light bulbs carried under a cradle well covered with blankets make quite a good chamber.

The *indications* for hot air are :—

(1) The period of convalescence from acute processes and to remove the ill-effects of inflammation, trauma and operative measures affecting joints more especially.

(2) Also the indefinite lesions classed under neuritis and neuralgia.

(3) Any painful parts.

P.S.—Personally I would warn practitioners not to use the hot-air methods as a *routine* in tuberculous affections.

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